ASSESSMENT PLAN
for the
NATURAL RESOURCE DAMAGE ASSESSMENT
of the
EAST BRANCH LITTLE CALUMET RIVER / BURNS WATERWAY AND ASSOCIATED LAKE MICHIGAN ENVIRONMENTS

February 2021

Prepared by:

U.S. Department of the Interior

U.S. Fish and Wildlife Service
and
National Park Service

State of Indiana

Department of Environmental Management
and
Department of Natural Resources

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LIST OF ACRONYMS

AMBH	ArcelorMittal Burns Harbor
AMSL	Above Mean Sea Level
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	Contaminants of Concern
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOI	United States Department of the Interior
EBLCR	East Branch Little Calumet River
GIS	Geographic Information System
IBI	Index of Biotic Integrity
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
INDU	Indiana Dunes National Park
ISG	International Steel Group
mg/l	milligrams per liter
mHAB	macroinvertebrate habitat assessment
mIBI	Macroinvertebrate Index of Biotic Integrity
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
OPA	Oil Pollution Act
PAH	Polycyclic Aromatic Hydrocarbon
ppm	parts per million
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
QHEI	Qualitative Habitat Evaluation Index
RCDP	Restoration and Compensation Determination Plan
RCRA	Resource Conservation and Recovery Act
TNC	The Nature Conservancy
TPH	Total Petroleum Hydrocarbons
µg/l	microgram per liter
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

CHAPTER 1 INTRODUCTION

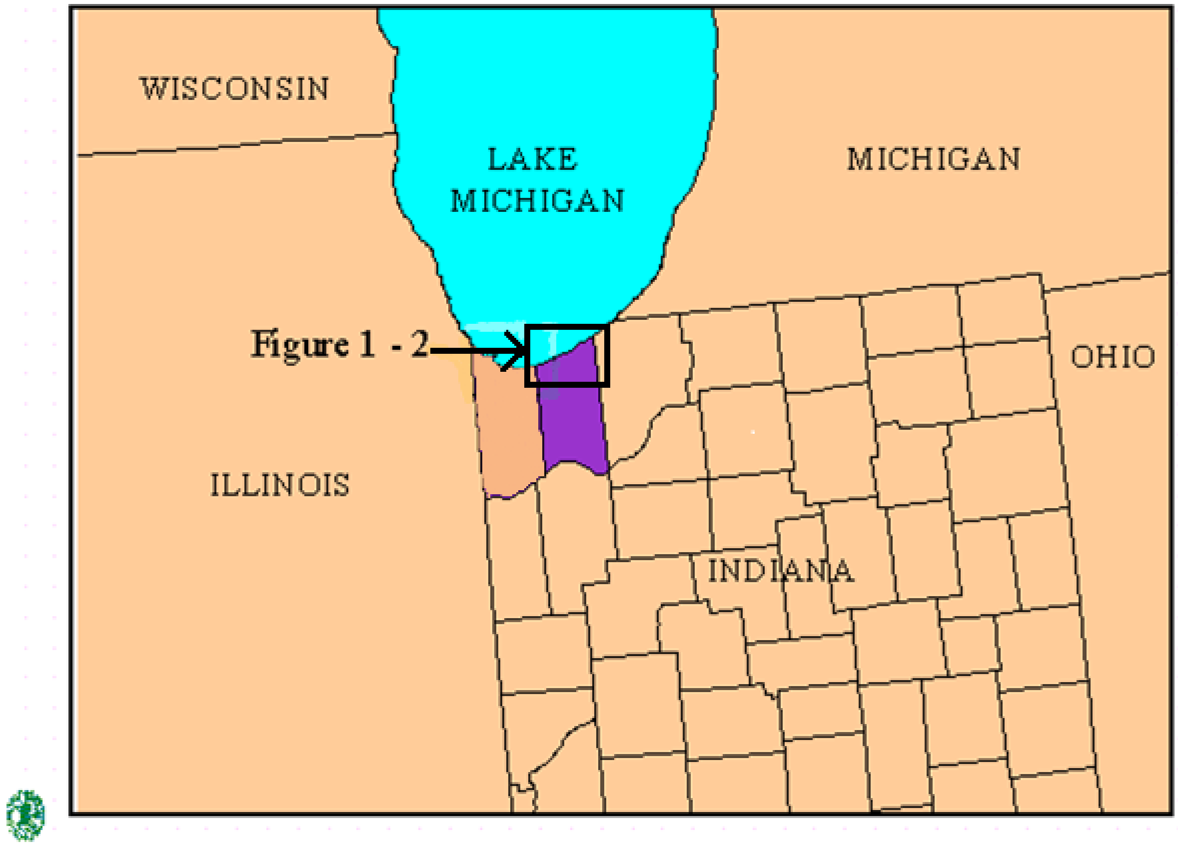
The United States Fish and Wildlife Service (USFWS), the National Park Service (NPS), the Indiana Department of Environmental Management (IDEM), and the Indiana Department of Natural Resources (IDNR), collectively referred to as the Trustees (Trustees), have initiated a natural resource damage assessment (NRDA) to address natural resource injuries resulting from the release of hazardous substances and oil to the waters of, and to the habitats associated with, the East Branch Little Calumet River (EBLCR), the Burns Waterway, and Lake Michigan, including land within the boundaries of the Indiana Dunes National Park (INDU) (Figures 1-1 and 1-2). This Assessment Plan will serve as the guiding document for all damage assessment activities.

Authority to Conduct a Natural Resource Damage Assessment

Pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended (42 U.S.C. 9601 *et seq.*), the Oil Pollution Act (OPA, 33 U.S.C. 2701 *et seq.*), and the Federal Water Pollution Control Act (the "Clean Water Act" (CWA)), as amended (33 U.S.C. 1251 *et seq.*), federal and state officials act on behalf of the public as Trustees for natural resources. The Secretary of the United States Department of the Interior (DOI) acts as a federal Trustee pursuant to the National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300.600) and Executive Order 12580, issued on January 23, 1987. For this NRDA action, the Secretary delegated his authority as the Department's natural resource Trustee to the Director of USFWS, with NPS identified as an affected bureau (242 Departmental Manual 6). In 1987, the Governor of the State of Indiana delegated Trusteeship for resources in that State to IDEM and IDNR.

Two sets of regulations have been promulgated to guide Trustees in the assessment of natural resource injuries and damages. In 1987, under the authority of CERCLA and CWA, DOI issued regulations (43 CFR Part 11) for conducting damage assessments following the discharge of oil or the release of hazardous substances. The purpose of the DOI regulations is "to provide standardized and cost-effective procedures for assessing natural resource damages." When Trustees complete an assessment according to these procedures, the results "shall be accorded the evidentiary status of a rebuttable presumption" (43 CFR 11.11). However, "the assessment procedures set forth in [the regulations] are not mandatory" (43 CFR 11.10). In 1996, the National Oceanic and Atmospheric Administration (NOAA), acting on behalf of the United States Department of Commerce (another federal Trustee) and under the authority of OPA, issued regulations at 15 CFR Part 990 for the assessment of damages resulting from a discharge or substantial threat of discharge of oil into or upon the navigable waters of the United States, adjoining shorelines, or the Exclusive Economic Zone. In this case, where both hazardous substances and oil have been released, application of the DOI regulations is appropriate, though the NOAA regulations may also provide useful guidance. Therefore, the damage assessment described in this Assessment Plan will follow the regulations promulgated by DOI at 43 CFR Part 11.

Fig. 1-1. General location of East Branch Little Calumet Assessment Area, Porter County, Indiana.



As required by the DOI regulations, the Trustees' decision to proceed with this assessment is based on the results of a Preassessment Screen (PAS), which was completed in September 2020 (USFWS et al. 2020). The PAS, which focused on the EBLCR and Burns Waterway, shows that the Trustees have a reasonable probability of making a successful damage claim. In accordance with the DOI regulations, the PAS was based on a rapid review of readily available information.

Purpose of the Assessment Plan

The purpose of this Assessment Plan (Plan) is to document the Trustees' basis for conducting a damage assessment, and to organize the proposed approach for determining and quantifying natural resource injuries and calculating the damages associated with those injuries. Another purpose of the Plan "is to ensure that the assessment is performed in a planned and systematic manner and that the methodologies selected…can be conducted at a reasonable cost…" (43 CFR 11.30(b)). By developing an Assessment Plan, the Trustees can ensure that the NRDA will be completed at a reasonable cost relative to the magnitude of damages sought. The Trustees also intend for this Plan to communicate proposed assessment methodologies to potentially responsible parties (PRPs) and to the public in an effective manner so that these groups can productively participate in the assessment process.

Fig. 1-2. The East Branch Little Calumet River Assessment Area, Porter County, Indiana.

This Assessment Plan lays out the steps the Trustees will undertake in calculating the two primary components of a damage claim: 1) the cost to restore, rehabilitate, replace, and/or acquire equivalent resources for the injured resources, and 2) "compensable values," or the monetary value of the natural resource services that were lost prior to the restoration of injured resources to their "baseline" condition.[1] Baseline is the condition or conditions that would have existed in the assessment area had the discharge of oil or release of hazardous substances under investigation not occurred (43 CFR 11.14(e)). The concept of baseline in the context of this damage assessment is discussed further in Chapters 3 and 4.

Decision to Perform a Type B Assessment

The DOI regulations provide for two types of assessments. A "Type A" assessment is a simplified assessment, requiring minimal field observation, that generates a damage claim through the application of a general computer model. A "Type B" assessment comprises a more comprehensive set of studies and analyses. Use of the Type A model is generally limited to the assessment of relatively minor, short duration discharges or releases that occur in coastal or marine environments or in the Great Lakes, among other conditions (43 CFR 11.33(b)). A Type B assessment is warranted when a Type A assessment is not.

In this case, a number of the conditions that would support the use of a Type A approach are not satisfied, including:

- The discharge or release was not of a short duration. In this case, discharges and releases of oil and hazardous substances have occurred over a period of many months.

- The discharge or release was not minor. In this case, discharges and releases of oil and hazardous substances have had a significant adverse effect on the natural resources within the assessment area.

- The discharge or release was not a single event. In this case, multiple discharges and releases have occurred.

Therefore, the Trustees have determined that a Type B assessment is warranted in this case.

Preliminary Estimate of Damages

As part of the planning process for a Type B assessment, the Trustees are required to prepare a preliminary estimate of natural resource damages (PED) (43 CFR 11.38). The purpose of this estimate is to guide the Trustees in the selection of specific technical, economic, or other methodologies for completing the assessment. The Trustees should proceed with the assessment

[1] The third component of a damage claim is the "reasonable and necessary" costs incurred by the Trustees to complete the damage assessment (43 CFR 11.15(a)(3)).

if there is sufficient confidence that the value of calculated damages will exceed the costs of performing the proposed damage assessment activities. The Trustees are not required to make public the results of the preliminary estimate of damages until the assessment is complete.

The Trustees have begun a preliminary estimate of damages and are confident that the value of damages determined through a NRDA will exceed their estimate of potential assessment costs. An important factor that reduces potential assessment costs is the existence, and availability, of relevant data that federal and state agencies and PRPs have already collected. As described later in this Plan, the Trustees intend to make use of these data to the maximum extent possible.

Coordination with Other Governmental Activities

The DOI regulations require the coordination of a damage assessment, to the extent possible, with response actions or other investigations being performed pursuant to the NCP (i.e., Superfund site cleanup activities). This requirement generally reflects circumstances in which a damage assessment is being undertaken with respect to a single site. In this case, investigations and response activities (pursuant to CWA) are planned or underway for the East Branch of the Little Calumet River and Burns Waterway. At a minimum, the Trustees intend to take into consideration the objectives of these activities during the implementation of this assessment. Whenever possible, the Trustees will explicitly coordinate damage assessment activities with other investigations and will ensure that appropriate consideration is given to parties undertaking or completing restoration activities that satisfy the Trustees' NRDA objectives.

Coordination among the Trustees is also an essential component of a cost-effective damage assessment. In this regard, the Trustees continue to cooperatively work together based on an October 2020 Memorandum of Understanding that provides a framework for coordination and cooperation among the Trustees and for the implementation of the Trustees' activities in furtherance of their natural resource Trustee responsibilities. The Indiana Department of Environmental Management acts as lead administrative Trustee and is the central point of contact for the parties that would like to communicate with any or all of the Trustee agencies.

Participation in the Assessment by Non-Trustee Parties

The Trustees invite public participation in this natural resource damage assessment. The Trustees will solicit public comments from PRPs, other affected federal or state agencies or federally-recognized Indian tribes, and any other interested members of the public following the completion of all major planning documents, including:

- The Assessment Plan;
- The Restoration and Compensation Determination Plan; and
- Assessment Plan addenda that describe significant additions or changes to the approach described in this Plan.

Each public comment period will last for a period of at least 30 calendar days. The public comment period for this Assessment Plan began on May 10, 2021, the day the Plan was published on USFWS webpage; therefore, the comment period will end on June 9, 2021. Comments may be submitted in writing to:

Ms. Anne Remek
Indiana Department of Environmental Management
100 North Senate Avenue
P.O. Box 6015
Indianapolis, IN 46206-6015

In addition, the Trustees have a public web page that will provide access to documents (https://www.fws.gov/midwest/es/ec/nrda/EastBranchLittleCalumet/index.html) used by the Trustees during the planning and implementation of the damage assessment. As this assessment proceeds, the Trustees will continue to seek out opportunities to encourage and facilitate public participation in the damage assessment process.

The Trustees have invited, and will continue to encourage, the active participation of the PRPs in the implementation of this damage assessment. It is the intention of the Trustees to work cooperatively with PRPs at each stage of the assessment and to take advantage of the expertise that PRPs may be able to provide. The Trustees recognize that PRPs are currently planning, conducting, and participating in activities that will better characterize environmental conditions in the assessment area and will perhaps help to address natural resource injuries. The Trustees strongly encourage PRPs to assist them in understanding the nature and extent of natural resource injuries, both by participating in the collection of data relevant to this natural resource damage assessment and by providing them with documentation of PRP activities (e.g., work plans, results, data analyses) as this information becomes available.

Organization of the Assessment Plan

Chapter 2 of this Assessment Plan provides background information that establishes the framework for this damage assessment. Chapter 3 describes the specific activities the Trustees propose to undertake to document the nature and degree of injuries to natural resources. Chapter 4 introduces the concept of damages, with an emphasis on the costs of restoration and potential methods by which the Trustees will calculate other natural resource damages. At this time, existing data are insufficient to complete a Restoration and Compensation Determination Plan, which would include the identification of a preferred restoration alternative from among a set of alternatives. However, Chapter 4 describes the types of restoration alternatives likely to be considered, the categories of compensable values for which the Trustees might claim damages, and the economic methodologies the Trustees would likely use to estimate these compensable values. Chapter 5 outlines the Trustees' approach for ensuring that any original data collection undertaken by the Trustees to support this assessment conforms to generally accepted standards of quality assurance and quality control. Chapter 6 lists the References cited in the Plan. Chapter 7 is a glossary of terms used in the Plan.

This damage assessment will address injuries to a variety of natural resources associated with the release of hazardous substances and oil from numerous sources in an area of extensive industrial activity. The complex nature of this assessment requires the Trustees to effectively communicate the proposed plan for calculating natural resource damages. As a first step toward achieving this objective, the Trustees include in this chapter background information on the geologic history and geographic scope of the assessment area, the history of industrial activity within that area, the nature of hazardous substance and oil releases to the environment, and the natural resources subject to injury resulting from those releases.

Geologic Setting of the Assessment Area and the Southern Lake Michigan Dunes

Northwest Indiana is made up of a variety of glacial landforms that remained as the large Lake Michigan lobe of the "Wisconsin" glacier melted and receded northward (Malott 1922). The Wisconsin glacier covered the Chicago region until about 14,500 years ago (Chrzastowski and Thompson 1994, Greenberg 2002). This region is also referred to as the Calumet region (Meyer 1954), which is named after the Calumet River that originates in LaPorte County, Indiana (Hartke et al. 1975). Over the last 3,800 years, the Calumet River formed, flowing west from its source through swampy lowlands between two former beach ridges into Illinois where it meanders 180 degrees, flowing back to modern day Marquette Park in Gary, Indiana, to its confluence with Lake Michigan at the Grand Calumet River lagoon. The formation of the Calumet River was completed 500 years ago, with its formation taking place as ancestral lake Michigan receded from 595.5 to 584 feet above mean sea level (AMSL) (Chrzastowski and Thompson 1994). Several man-made modifications to the Calumet River in the last century have transformed it into two distinct rivers, the Little Calumet and the Grand Calumet, with three new outlets to Lake Michigan and one to the Mississippi River watershed.

The northern and central portions of Lake and Porter Counties lie within the generally east-west-trending subdivisions of the region: the Calumet Lacustrine Plain and the Valparaiso Moraine, respectively (Hartke et al. 1975). The Calumet Lacustrine Plain is the former bed of glacial Lake Chicago, the precursor to present-day Lake Michigan. The lacustrine plain and present shoreline of Lake Michigan developed over the past 14,500 years as glacial ice stalled and retreated (Greenberg 2002). Significant man-made changes have occurred since the late 1800s (Hartke et al. 1975). Three relict shorelines capped by sand dunes eventually came to serve as railroad and highway corridors through the area (Hartke et al. 1975).

The smooth shorelines of southern Lake Michigan allowed for a continuous aqueous transport pathway of fine to medium sand down both east and west shores, converging between the former mouth of the Calumet River in Gary and Trail Creek in Michigan City (Chrzastowski et al. 1994). The dunes of the Indiana coast functioned as the principal sediment sink and when uncovered by lake retreat, the sand was transported by the wind (eolian transport) into the dunes, extending high above Lake Michigan (Chrzastowski et al. 1994). Some of the highest dunes, including Mt. Tom (192 feet above Lake Michigan in Indiana Dunes State Park), still exist and are features of the area. The largest dune of all no longer exists; Hoosier Slide near Michigan City (200 feet tall) was hauled away by the early 1900s to become glass jars and windowpanes (Watts 1975, Greensberg 2002).

On the west end of the present-day Indiana Dunes National Park (INDU), the near shore Nippissing era dunes (formed 5,500 to 4,000 years ago) are separated from the inland Tolleston Dunes (formed 11,000 years ago) by the Long Lake marsh complex. Where the wetland ends at Midwest Steel (now U.S. Steel Midwest Division), the two dune systems merge so that the high dunes extending through Indiana Dunes State Park to Beverly Shores are Nippissing on the lakeward side and Tolleston on the landward side. At the south and east parts of the National Park, Tolleston and Calumet Dunes (formed 12,000 years ago) are separated by the Great Marsh (Greenberg 2002, Chrzastowski and Thompson 1994). During the last 3.8 Ka (thousand years), the prime (Bethlehem) Central Dunes formed beginning with the Calumet and Algonquin beaches, and were some of the highest and most complex dunes of Southern Lake Michigan. Within this area, a rare turret dune, Howlin' Hill, stood 150 feet above Lake Michigan and its base was the size of 68 football fields (Greenberg 2002).

Indiana Dunes Ecological Values

Over one hundred years ago Henry Chandler Cowles (University of Chicago) wrote a premier treatise on plant ecology and ecological succession using the dunes of Indiana as his study area (Cowles 1899). Although large areas of the Indiana dunes have been obliterated, the surviving habitat supports a variety of life virtually without equal in this country. The National Park Service (NPS) and The Nature Conservancy (TNC) rank Indiana Dunes the 3rd highest of all U.S. National Parks in plant diversity even though the top two (Great Smokey Mountains and Grand Canyon) are both 33 times larger. As for why many dunes have disappeared, Hartke et al. (1975) says it well:

> "High-silica sand mining operations, which were once a big industry in the Calumet region, are now greatly reduced in size and number. Abundant good-quality high-silica sand still remains in northern Lake and Porter Counties, but it is inaccessible because the land containing these deposits is owned by private, state, and federal organizations, including public park systems, all of which refuse to remove the sand."

The history of these competing interests is part of what makes this area special and is important to understanding the context of the present-day assessment area.

Recent History of Indiana Dunes 1860-2010

1860-1899

In 1869 federal funding led to the improvement of Calumet Harbor on Chicago's south side (Cook County, IL). A waterway from the Calumet River was constructed across the Calumet marsh in Illinois to Lake Michigan. This essentially split the Calumet River into the Little Calumet River and the Grand Calumet River and caused Calumet Harbor to replace the Chicago River as the city's most important shipping port.

1900-1910

In 1901, construction of the Indiana Harbor and Ship Canal was begun in Lake County, IN. A large canal was excavated straight north to connect the Grand Calumet River with Lake Michigan in what is now Indiana Harbor. A few miles east, US Steel purchased 9,000 acres along 7 miles of Indiana Lake Michigan shoreline in Lake County in 1902. They destroyed the high dunes along the lakeshore and moved and straightened two miles of the Grand Calumet River to build Indiana's first integrated steel mill.

1911-1920

Construction of the Cal-Sag channel (Cook Co, IL) began in 1911 to connect the Little Calumet River and Calumet Harbor with the Chicago Sanitary and Ship Canal (completed in 1900) which flows to the Illinois and Mississippi River systems.

The National Dunes Park Association was created in 1916, the same year that the National Park Service was established. A Chicagoan who was knowledgeable about the magnificence of Lake Michigan's dunes, Stephen Mather, became NPS' first Director. The NPS recommended to Congress buying 9,000-13,000 acres of remaining dunes within Indiana. Indiana's State Park Memorial Committee, under the leadership of Richard Lieber, raised funds to purchase two State Parks in Central Indiana (McCormick's Creek and Turkey Run) in 1916 (Franklin and Schaeffer 1983). Soon thereafter, WWI distracted national attention away from park preservation efforts.

1921-1930

The Indiana legislature gave approval for a modest Dunes State Park on March 1, 1923; however, no funds were appropriated for its purchase. A channel, Burns Ditch, was cut through the west end of the Central Dunes from the Calumet River to Lake Michigan in Porter County in 1926. This portion of the Calumet River is now considered the Little Calumet River, and the East Branch Little Calumet River.

Two thousand acres of dunes and 3.27 miles of shoreline were purchased with funds from private citizens (Judge Elbert Gary of U.S. Steel, Julius Rosenwald of Sears and Robuck, and a loan from industrial magnate Samuel Insull) to create Indiana Dunes State Park in 1927 (Cockrell 1988, Franklin and Schaeffer 1983). In 1929, the Northern Indiana Public Service Company (NIPSCO) bought 300 acres on the shore of Lake Michigan just west of the little lake front town of Dune Acres.

1940-1950

The steel industry in the U.S. prospered during and after World War II, while the steel industries in Germany and Japan lay devastated by Allied bombardment. In the late 1940s, the U.S. Army Corps of Engineers began advocating for another deepwater port in Indiana.

1951-1960

The Save the Dunes Council was founded in the summer of 1952 with two goals: to protect the Central Dunes (and 5 miles of Lake Michigan shoreline) and create a park that protected the full diversity of the dunes in perpetuity. The Central Dunes area consisted of the highest and widest expanse of dunes, with some of the best wetlands and savanna (Franklin and

Schaeffer 1983). Meanwhile, Bethlehem Steel Corporation (a Pennsylvania company) was doing very well in the 1950s, manufacturing 23 million tons of steel per year. In 1956, Bethlehem Steel Corporation (Bethlehem), through a subsidiary (Lake Shore Development Corporation), bought 3,800 acres of the Central Dunes (including a 5-mile stretch of Lake Michigan). When Bethlehem Steel Corporation revealed that it had been buying land in the area (1958), preservationists denounced Bethlehem's plan to destroy these unique natural formations for the construction of another steel mill in the area (Greenberg 2002).

The St. Lawrence Seaway was completed and began operation in 1959, connecting more than 15 major ports on the Great Lakes to global markets. Also, in 1959, NIPSCO built two coal-fired generating stations and a 345,000-kilowatt substation on the dunes that they purchased in 1929, anticipating the coming need to provide power for the future growth in the area.

1961-1970

On May 18, 1961, Indiana's legislature formally selected the Burns Ditch area in Porter County as the site for Indiana's first public port. Later, that same year, National Steel Corporation built a steel finishing facility called Midwest Operations ("Midwest"), in Portage, Indiana on 1,100 acres straddling Burns Waterway on Lake Michigan. (U.S. Steel bought the Midwest plant in 2003). Bethlehem announced in 1962 its intention to build a steel finishing mill on the central dunes it purchased several years before. In early 1963, Bethlehem leveled the Central Dunes and built its largest plant. By 1964, the Bethlehem Burns Harbor plant consisted of a 160-inch plate mill, the cold-rolled sheet and tin mill complex, and an 80-inch "hot" mill, which were producing thousands of tons of light flat-rolled products.

In 1965, the Indiana General Assembly appropriated $35 million in funding for Burns Harbor, Indiana's first public port, and its groundbreaking ceremony was on October 10, 1966. Although the preservationists had battled fiercely in the legislature to prevent federal funding for the port construction to save the Central Dunes, once Bethlehem eliminated the dunes, the stalemate between the pro-harbor development forces and the preservationists was broken. On November 5, 1966, Congress passed Public Law 89-761, which authorized the creation of the Indiana Dunes National Lakeshore (now a National Park) protecting as many as 8,330 acres of remaining dune remnants along the shores of Lake Michigan. It also authorized federal funds for the construction of the Port of Indiana (Greenberg 2002).

Bethlehem started up its first large blast furnace in late 1969. The official opening of the port of Indiana-Burns Harbor was in July 1970.

1971-1999

A second giant blast furnace was fired up in early 1972 (https://www.burnsharbor-in.gov/203/Local-History), giving Bethlehem a total iron-making capacity of approximately 10,000 tons a day.

Congress authorized additions to the Indiana Dunes National Park on September 24, 1976 (Engel 1983), including corridors purchased in 1978 along the Little Calumet River and Salt Creek. The purchase provided preservation of the area, as well as improved public access to fishing, and connected the east and west units of the national park. Three subsequent expansion bills for the park (1980, 1986, and 1992) have increased the size of the park to more than 15,000 acres.

2000-2010

In 2001, Bethlehem filed for bankruptcy. In 2003, the company was dissolved and its remaining assets, including the six plants, were acquired by the International Steel Group. International Steel Group (ISG) was in turn acquired by Mittal Steel in 2004, which then merged with Arcelor to become ArcelorMittal in 2006.

Geographic Scope of the Assessment Area

As noted in Chapter 1, this damage assessment will focus on the East Branch Little Calumet River, Burns Waterway, and associated Lake Michigan environments, along with the riparian and upland habitats closely associated with these waters, including lands within the boundaries of the Indiana Dunes National Park. The following descriptions establish more specific boundaries for what will be referred to as the "assessment area" (see Fig. 2-1 and Fig. 2-2).

East Branch Little Calumet River

The East Branch Little Calumet River (EBLCR) is oriented in an east-west direction. A major tributary, Salt Creek, flows north into the EBLCR on NPS property. Just upstream of the Salt Creek confluence, Samuelson Ditch flows south to join the EBLCR, carrying ArcelorMittal Burns Harbor's (AMBH's) Outfall 001 discharges. The EBLCR joins the Burns Waterway approximately 1.4 miles south of its confluence with Lake Michigan. The EBLCR originates near Michigan City, and flows west from this point for approximately ten miles to its confluence with the Burns Waterway. The assessment area includes the western 4.5 miles of the EBLCR, along with the riparian, wetland and upland habitats closely associated with these stretches of the river.

Burns Waterway

The Burns Waterway originates near the intersection of Interstate I-65 and I-94 in southeastern Gary, Indiana at the confluence of the Little Calumet River and Deep River. The Burns Waterway flows northeast for approximately 6.9 miles before entering Burns Small Boat Harbor and into Lake Michigan. The EBLCR joins the Burns Waterway 1.4 miles south of Lake Michigan. The assessment area includes the northern 2 miles of the Burns Waterway.

Lake Michigan

The Trustees have not defined a specific boundary within which Lake Michigan resources will be subject to assessment. The establishment of such a boundary depends upon a better understanding of injuries to the Burns Waterway and EBLCR resources and the nature of

Fig. 2-1. Proposed sampling locations in the East Branch Little Calumet River Assessment Area, Porter County, Indiana.

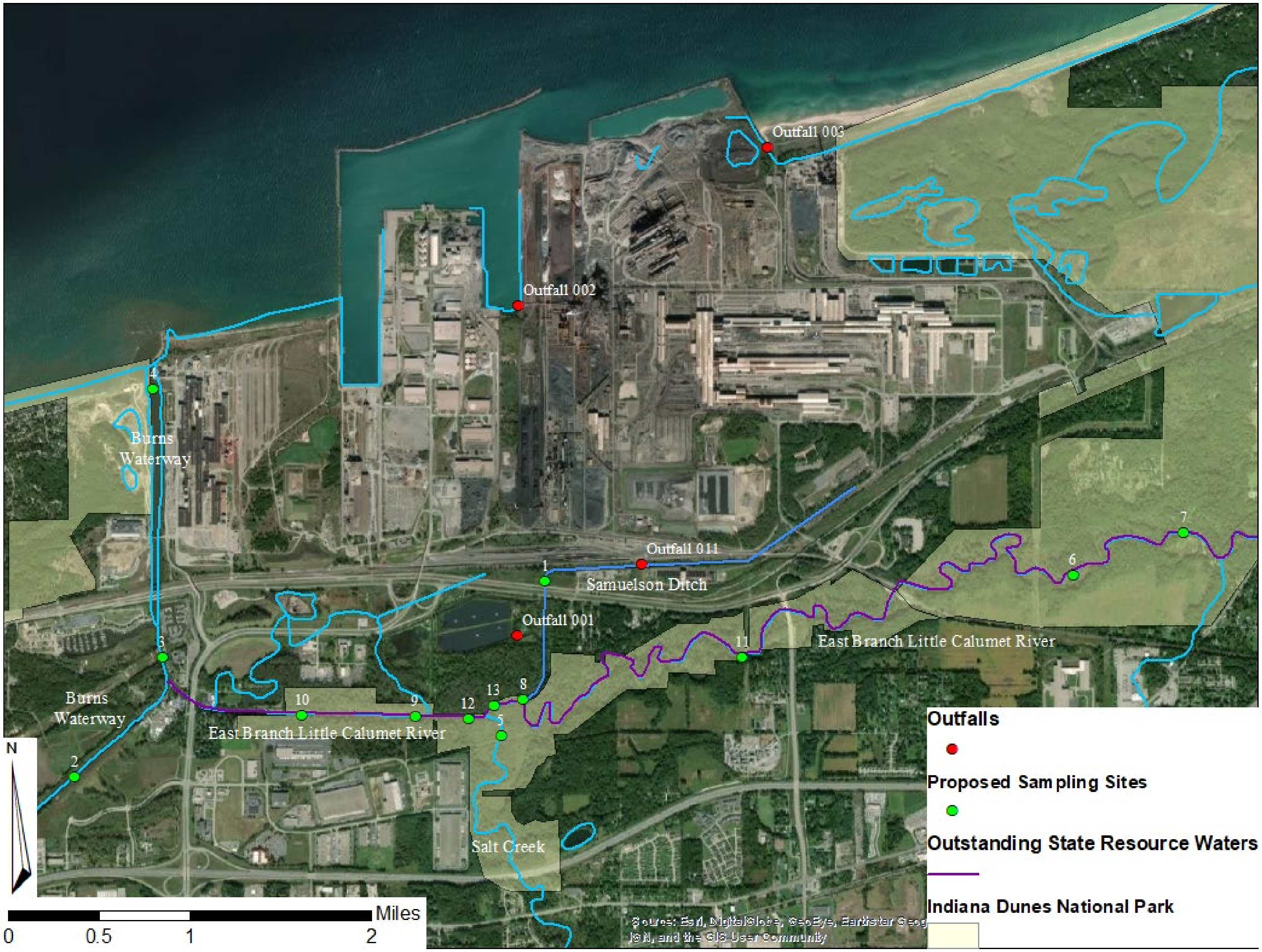
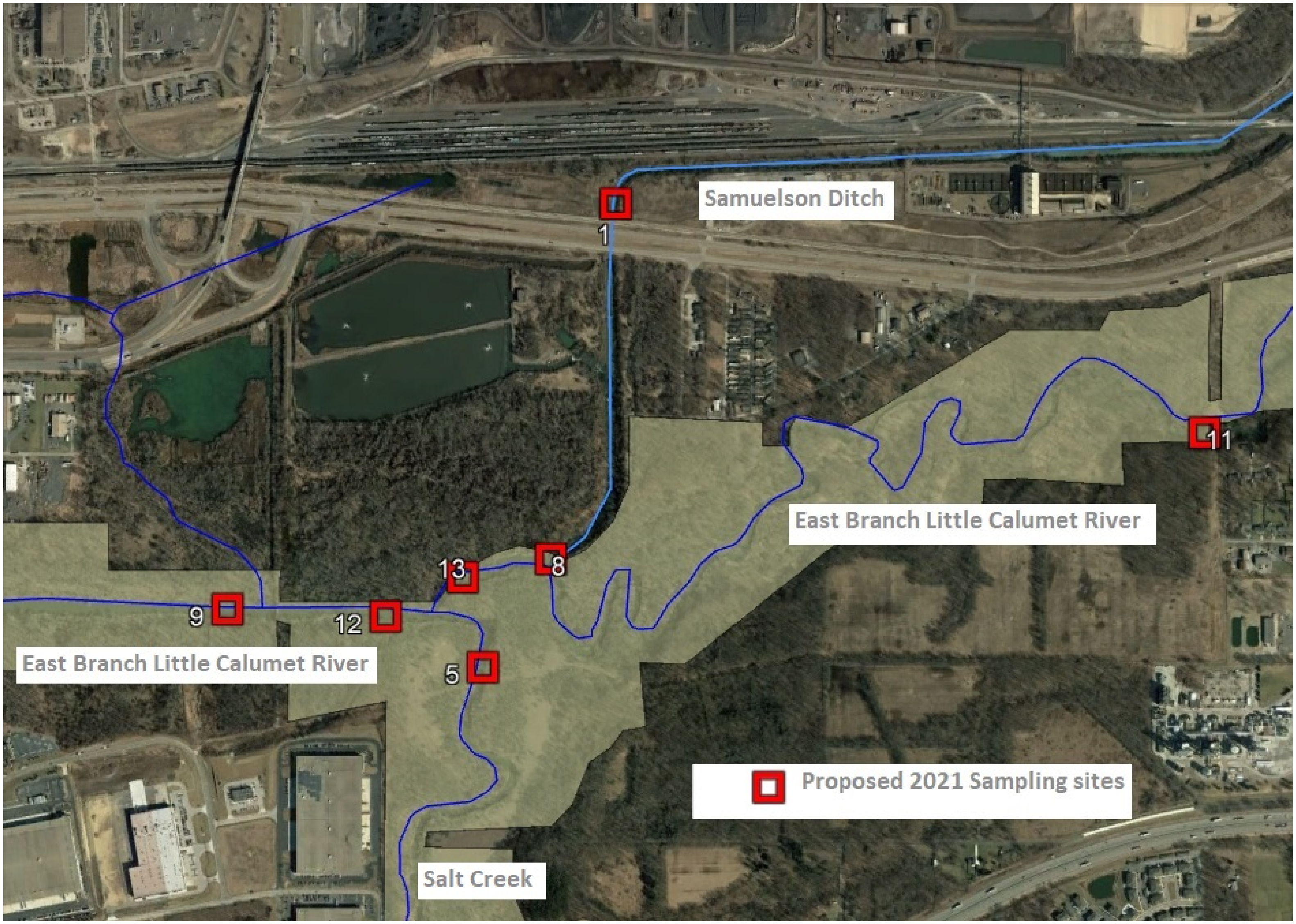


Fig. 2-2. Expanded view of proposed sampling locations in the East Branch Little Calumet River Assessment Area, Porter Co., IN.



the relationship between the river, the waterway, and the lake. At a minimum, the Trustees will review existing information to assess the extent to which the EBLCR and Burns Waterway contribute to the degradation or diminishment in value of lake resources and the services these resources provide.

Indiana Dunes National Park

The Indiana Dunes National Park (INDU) is a unit of the National Park Service comprising approximately 15,000 acres east, south, and west of the greater Burns Harbor Industrial Complex, which is home to U.S. Steel Midwest Division, ArcelorMittal Burns Harbor, NIPSCO Bailly Generating Station, and many other steel manufacturing support companies.

Industrial Activity and Identification of Potentially Responsible Parties

The industrial development of the assessment area was alluded to in the above timeline. The industrial cornerstones of the assessment area include:

> Located in the largest steel-producing region in North America, the **Port of Indiana-Burns Harbor** has nearly 600 acres of land and 30 port companies, including 15 steel-related companies and three steel mills. The port handles about 9,000 rail cars, 75 ships, 350,000 trucks, 375 barges and 200 Great Lakes vessels a year.
>
> **ArcelorMittal Burns Harbor** is the easternmost of the three large steel mills on the Indiana shore of Lake Michigan covering almost 2,000 acres. This was the last large integrated steel plant to be built in the USA. It has the capacity to produce around 5 million tons of raw steel per year. It was the company's desire to compete with the other old steel companies that were prospering along the Lake Shore, with water access for the bulk materials for steel: coal, limestone, and iron ore. The plant has two blast furnaces, two coke oven batteries, iron producing, steel producing, hot rolling, finishing and plate rolling and heat treating mills. The facility manufactures intermediate and final products consisting of coke and coke-making byproducts, sinter, molten iron, raw steel, steel slabs, hot rolled strip, plate, cold rolled strip and hot dip galvanized strip. It provides steel to the automobile, tube, pipe, shipbuilding, drum, appliance, HVAC, tank car and rail car-making industries. Bankrupt Bethlehem was bought by ISG for $1.5 billion in 2003, and Mittal bought ISG for $4.5 billion in 2004. Mittal merged with Arcelor to become ArcelorMittal in 2006; ArcelorMittal, based in Luxembourg, is now the largest steel company in the world (https://clui.org/ludb/site/burns-harbor-steel-plant; https://usa.arcelormittal.com/our-operations/steelmaking/burnsharbor). In Indiana, ArcelorMittal owns the Burns Harbor mill and a large mill at Indiana Harbor.
>
> **National Steel** built the first steel finishing plant along Lake Michigan straddling the Burns Waterway in Porter County in 1961 on 1,100 acres. This plant is still in operation

today (as **U.S. Steel**), however the 57 acre portion of the plant property found on the west side of Burns Waterway, the **Portage Lakefront and Riverwalk**, is now owned by NPS, and managed by the Portage Parks and Recreation Department.

Based on National Pollutant Discharge Elimination System (NPDES) records maintained by IDEM, the U.S. Army Corps of Engineers (Corps) identified 15 **NPDES permit dischargers** to the assessment area (Table 2, p.7; U.S. Army Corps 2020).

Approximately 26 **facilities** located in the vicinity of the Burns Harbor are subject to regulation under the Resource Conservation and Recovery Act **(RCRA)**, meaning they generate, transport, or treat, store or dispose of hazardous wastes (U.S. Army Corps 2020).

Based on information available at this time, and in accordance with the statutory provisions in section 107(a) of CERCLA, the Trustees have identified ArcelorMittal as a PRP who may be liable for damages associated with injuries to natural resources occurring in the assessment area. The Trustees may identify additional PRPs following the review of additional information.

Hazardous Substances and Oil Present in the Assessment Area

The Trustees will focus the assessment on natural resource injuries and damages which are associated with the release of ammonia, cyanide, oil and oil-related compounds, and metals. The purpose of this section is to briefly describe these four categories of contaminants, focusing on general characteristics, sources and environmental effects. "The most serious pollutants from iron steel making are ammonia, sulfate, chloride, fluoride, cyanide, phenol, oil, arsenic, cadmium, chromium, lead, zinc, iron, plus temperature, suspended solids, pH and oxygen consuming materials" (UGSI Chemical Feed, Inc., https://ugsichemicalfeed.com/metals-industry.php).

Ammonia

Ammonia is one of the most common pollutants in aquatic systems and is toxic at relatively low concentrations (Augspurger et al. 2003). Most steel making operations utilize coke (made from heating coal in the absence of air) to power its furnaces. Ammonia is a by-product of the coke making process (World Bank Group 1998, Sarna 2019). Ammonia is also added to sintering and blast furnace operations to create a protective atmosphere and as a source of hydrogen to enhance steel manufacturing (Appl 1999, Wilyman 1985, USEPA 1994, Linde group undated). Sinter plant and blast furnace gas scrubbing operations capture excess ammonia and cyanide (Decaigny and Krikau 1970).

In addition to anthropogenic inputs, ammonia can be generated through natural processes, such as bacterial production through nitrogen fixation, ammonification, and dissimilatory reduction of nitrate. Sediment pore-water concentrations of ammonia typically exceed those of overlying surface water (Frazier et al. 1996). Ammonia is known to be more stable in anoxic conditions because it undergoes less microbial degradation (Reddy and Patrick 1979).

Cyanide

Cyanide consists of a carbon atom and a nitrogen atom joined by a triple bond (CN). Cyanide has a reputation as a toxic killer – derived from the fact that it has been used to kill more humans (through chemical warfare, genocide, murder, suicide, and capital punishment) than any other chemical throughout history. There are many beneficial uses of cyanide in a wide variety of manufacturing processes. It is found throughout the natural environment in many forms (Eisler 1991), with cyanogenic plants and forage crops being the primary human exposure route. Despite its many forms, only hydrogen cyanide (HCN) and cyanide (CN^-) are actively toxic. Cyanide is a potent asphyxiant but can also be absorbed dermally or internally to toxic levels. However, most natural (and sublethal) exposures are quickly detoxified and excreted. "All available evidence suggests that cyanides are neither mutagenic, teratogenic, nor carcinogenic. Moreover, there are no reports of cyanide biomagnification or cycling in living organisms, probably owing to its rapid detoxification. Cyanide seldom persists in surface waters and soils owing to complexation or sedimentation, microbial metabolism, and loss from volatilization" (Eisler 1991).

Cyanide contamination in steel industry wastewater is a long-standing environmental problem (Mondal et al. 2019, Petelin et al. 2008). Cyanide can be generated in the coke making process, in sintering, and in blast furnace gases; it is then relegated to be managed in wastewater (Luzin et al. 2012). Massive kills of freshwater fish by accidental discharges of cyanide wastes are common (Holden and Marsden 1964; Leduc 1978; Towill et al. 1978; USEPA 1980). Cyanide ordinarily does not persist in the environment after it has been released and does not tend to accumulate in soils and sediments in its most active form (Eisler 1991). Chronic effects from long-term exposures (greater than 60 days) to free cyanide concentrations of 5.0 and 5.2 µg/l have resulted in reducing and completely inhibiting spawning of bluegill, respectively (Smith et al. 1978, Smith et al. 1979, USEPA 1980). Leduc (1984) reported other chronic endpoints in several species of fish, such as reduced egg production, reduced egg viability, and reduced swimming performance, at concentrations ranging from 5-10 µg/l.

Oil and Related Compounds

Oil is a term used to classify a variety of complex mixtures of organic compounds and trace elements generally associated with the petrochemical industry. In general, four classes of petroleum hydrocarbons make up the non-animal or plant oils: alkanes, naphthenes, aromatics, and alkenes. Crude or refined oils have the potential to enter the environment wherever they are used, manufactured, stored, or otherwise handled. Releases to the environment can occur as a result of direct discharge to the land surface or to surface water, and can move through the environment via numerous pathways, including the discharge of ground water to surface water, and surface water runoff. Oil can be harmful to the environment as a result of both its physical and chemical properties.

A subcategory of the aromatic hydrocarbons is a group of chemicals known as polycyclic aromatic hydrocarbons, or PAHs. In addition to their occurrence as constituents in petroleum products, PAHs are also formed as a product of incomplete combustion. Sixteen PAHs are classified as priority pollutants by the United States Environmental Protection Agency (USEPA), including naphthalene. Exposure to PAHs has been associated with a variety of adverse effects in fish, birds, mammals, and other wildlife (Beyer et al. 1996).

Metals

Metals are naturally occurring elements that are often found, as a result of industrial and commercial activity, at elevated concentrations in the environment. Metals of potential concern in the environment include aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver and zinc. Cadmium, lead, and mercury are among the more prominent metals which have been associated with adverse effects observed in natural resources, including invertebrates, fish, birds, and mammals (Beyer et al. 1996).

Natural Resources in the Assessment Area

The East Branch Little Calumet River and Burns Waterway contain a wide range of natural resources. In addition, the area has the capacity to support a much richer and much more diverse suite of resources than are currently present.

The DOI regulations define five categories of natural resources for which natural resource damages may be sought: surface water resources, ground water resources, air resources, geologic resources, and biological resources. Surface water resources include both the water column and associated bed or bank sediments. The following sections briefly describe each of these categories in the context of the assessment area.

Surface Water Resources

The surface water resources in the assessment area include the water and the bed and bank sediments of the EBLCR, Burns Waterway and Harbor, and nearshore Lake Michigan. These resources are particularly important in the context of this damage assessment, as they have been and continue to be the principle receptors of hazardous substances and oil released to the environment within the assessment area. The contamination of these resources has both direct and indirect impacts on the health of biological resources. For example, contaminated sediments can cause injury to benthic invertebrate populations, which in turn can result in injuries to resident fish populations for whom the invertebrates are a source of food. Similarly, injury to invertebrates and/or fish resulting from exposure to contaminated sediments and surface water can lead to other food chain impacts. In addition, contaminated sediments serve as a source of continuing releases of hazardous substances to the water column.

Ground Water Resources

Ground water resources include the water in a saturated subsurface zone and the rocks or sediments through which this water flows. Ground water resources serve as a potential pathway for contaminants to migrate from their source to surface water resources. Since ground water within the assessment area is not used as a public drinking water supply (as a result of contamination), this assessment will not focus on this natural resource.

Air Resources

Air resources are typically assessed in the context of their ability to serve as a pathway for hazardous substances to reach, and potentially injure, other resource categories. The Trustees do not consider an assessment of the air pathway to be a cost-effective use of assessment resources, as deposition of airborne contaminants is assumed to play a relatively minor role in causing the potential injuries that will be the focus of this damage assessment.

Geologic Resources

Geologic resources include soils and sediments that are not otherwise accounted for under the definition of surface water or ground water resources. In this case, geologic resources include the soils and sediments located in upland and wetland areas closely associated with the East Branch Little Calumet River, and the soils of lands within the Indiana Dunes National Park, including the Portage Lakefront and Riverwalk beach.

Biological Resources

Along with surface water resources, biological resources comprise a key component of this damage assessment. The Trustees will focus on the assessment of injuries to three categories of biological resources: freshwater mussels, other benthic invertebrates and fish. As described in Chapter 3, the food web relationship between these resources will provide the framework for their assessment.

Benthic Invertebrates

The benthic invertebrate community has frequently been used to assess the environmental quality of aquatic ecosystems. These organisms are sensitive to both physical and chemical changes in the environment. They also have sufficiently long life cycles and low motility, and, therefore, reflect past and present environmental conditions. An unstressed community supports a large number of different groups with relatively few individuals within each group. However, when a community is stressed, the number of benthic groups decreases and the relative number of individuals in the remaining tolerant groups increases.

There have been a few studies conducted on the benthic organisms at many locations throughout the entire watershed of EBLCR and Burns Waterway. In 2012 and 2013, IDEM sampled macroinvertebrates at several locations in Samuelson Ditch and the EBLCR that are relevant to understanding the potential impact of ArcelorMittal's releases of ammonia and cyanide in 2019. Macroinvertebrate Index of Biotic Integrity (mIBI) scores using the multi-habitat method (mHAB) (IDEM 2010) for samples suggest slightly lower than passing scores while Quantitative Habitat Evaluation Index (QHEI) (Ohio EPA 1989a, Ohio EPA 1989b) aquatic habitat scores are slightly better than the average possible score. A full understanding of what is happening with these resources in the assessment area is needed.

Fish

Fish diversity within the EBLCR and Burns Waterway system was evaluated using the index of biotic integrity (IBI), a measure of fish community health (Simon et al. 1988). The fish community continues to rate poorly relative to the historic diversity of the greater watershed and below expectations for Southern Lake Michigan tributaries. IDEM fish community assessments in 2012 and 2015 averaged IBI scores of 25.1 while QHEI scores averaged 54. These IDEM fish sampling events in the EBLCR revealed 33 species of fish at seven locations (IDEM unpublished, accessed April 2000). Largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*) and common carp (*Cyprinus carpio*) were the most abundant species, but only carp were found at all seven locations. The most upstream station (Samuelson Ditch just upstream of the South Shore Railroad bridge) had only three species and 216 individuals; species diversity increased in a downstream direction. Low numbers of individuals and low fish species diversity were observed throughout. The IBI rating at all five downstream locations was "poor."

Freshwater Mussels

The East Branch Little Calumet River within Indiana Dunes National Park once supported 18 native mussel species. Only two of those native mussels remain with distributions being either sporadic and diffuse (White Heelsplitter, *Lasmigona complanata*) or isolated in a single, small tributary (Ellipse, *Venustaconcha ellipsiformis*). Without intervention, both of these species are at risk of extirpation from this area (Charles Morris, personal com).

Recreational Uses in The Assessment Area

Emergency closures of beaches and waterways due to releases of toxic and hazardous substances result in lost recreational uses of beaches, boating and fishery resources. The beaches and the angling opportunities afforded by Lake Michigan are without parallel in the inland United States. Around two million people visit Indiana Dunes National Park each year, with beach activities, such as walking along the beach and swimming, being the most common visitor use (NPS Stats 2020, Holmes et al. 2010). The East Branch Little Calumet River is a prolific trout and salmon fishery, as well as a popular water trail, heavily used for sport fishing and paddling (canoeing and kayaking) (Dan Plath, personal com). Sailing, boating, and recreational fishing are popular recreational activities on Lake Michigan (NPS 2020). The Lake provides angling opportunities for fish species such as coho (*Oncorhynchus kisutch*) and chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Onchorynchus mykiss*), lake trout (*Salvelinus* *namaycush*), yellow perch (*Perca flavescens*), and smallmouth bass (*Micropterus dolomieui*) (IDNR 2020).

Confirmation of Exposure

Prior to undertaking a "Type B" assessment, the Trustees must "confirm that at least one of the natural resources identified as potentially injured in the preassessment screen has in fact been exposed to the oil or hazardous substance" (43 CFR 11.34(a)(1)). The Trustees' Preassessment Screen identifies resources within three of the five categories listed above as potentially injured. In order to document exposure, the Trustees must show that "all or part of a natural resource is, or has been, in physical contact with oil or a hazardous substance, or with media containing oil or a hazardous substance" (43 CFR 11.14(q)). The following data summary satisfies this requirement by confirming exposure of biota in the EBLCR and Burns Waterway to contaminants of concern (COCs). AMBH's NPDES permit sets forth numeric effluent limitations applicable to the discharge from Outfall 001, including effluent limitations for Free Cyanide and Ammonia-Nitrogen. For the period of August 1 through August 31, 2019, AMBH exceeded numeric effluent limitations, in violation of Part I.A.1 of the NPDES permit, as shown in Table 2-1.

The concentrations of COCs in surface water have confirmed that aquatic natural resources have been exposed to a hazardous substance. While ammonia and cyanide are contaminants of particular concern to the Trustees, we are concerned that natural resources in the assessment area may have been exposed to a variety of oils and hazardous substances.

The purpose of this damage assessment is to assess the cumulative injuries resulting from exposure to multiple contaminants and to determine the appropriate scope and scale of restoration and compensation. Table 2-1 confirms the exposure of natural resources in the assessment area to hazardous substances. Confirmation of exposure could also be achieved using data associated with the invertebrate and fish communities in the assessment area.

Table 2-1. Ammonia-Nitrogen and Cyanide Water Exceedances from ArcelorMittal Burns Harbor's Outfalls

	Concentration		Loading	
Date	Limit	Result	Limit	Result
Ammonia-Nitrogen 7-Day Average (Outfall 001)				
August 1 - 7, 2019	0.37 mg/l	0.48 mg/l	385 lbs/day	460 lbs
August 8 - 14, 2019	0.37 mg/l	0.65 mg/l	385 lbs/day	679 lbs
August 15 - 21, 2019	0.37 mg/l	0.49 mg/l	385 lbs/day	488 lbs
August 29 - 31, 2019	0.37 mg/l	0.39 mg/l	385 lbs/day	401 lbs
Ammonia-Nitrogen Daily Maximum (Outfall 001)				
August 5, 2019	0.52 mg/l	0.92 mg/l	540 lbs/day	901 lbs
August 11, 2019	0.52 mg/l	0.92 mg/l	540 lbs/day	911 lbs
August 12, 2019	0.52 mg/l	1.0 mg/l	540 lbs/day	1117 lbs
August 13, 2019	0.52 mg/l	0.80 mg/l	540 lbs/day	891 lbs
August 14, 2019	0.52 mg/l	0.57 mg/l	540 lbs/day	562 lbs
August 15, 2019	0.52 mg/l	0.81 mg/l	540 lbs/day	751 lbs
August 16, 2019	0.52 mg/l	0.53 mg/l	540 lbs/day	554 lbs
Free Cyanide Daily Maximum (Outfall 001)				
August 12, 2019	8.8 ug/l	160 ug/l	9.9 lbs/day	178.8 lbs
August 13, 2019	8.8 ug/l	220 ug/l	9.9 lbs/day	244.9 lbs
August 14, 2019	8.8 ug/l	106 ug/l	9.9 lbs/day	104.9 lbs
August 15, 2019	8.8 ug/l	125.2 ug/l	9.9 lbs/day	116.3 lbs
August 16, 2019	8.8 ug/l	11.9 ug/l	9.9 lbs/day	12.4 lbs
Free Cyanide Monthly Average (Outfall 001)				
August 2019	4.4 ug/l	30 ug/l	5.0 lbs/day	29.2 lbs/day
Total Cyanide Daily Maximum (loading) (Outfall 011)				
August 12, 2019			21 lbs/day	136 lbs
August 13, 2019			21 lbs/day	188 lbs
August 14, 2019			21 lbs/day	138 lbs
August 15, 2019			21 lbs/day	110 lbs
August 16, 2019			21 lbs/day	35 lbs

CHAPTER 3 INJURY DETERMINATION AND QUANTIFICATION

Introduction

The injury assessment, comprising both injury determination and injury quantification, is the process that informs the Trustees' ultimate claim for natural resource restoration costs and, if warranted, "compensable values," or compensation for losses incurred prior to the completion of restoration activities (43 CFR 11.83(c)(1)). The DOI regulations instruct the Trustees to take the following steps in completing the injury determination phase of the assessment (43 CFR 11.61(c)):

- Identify and categorize each potentially injured resource;
- Select and implement injury determination methodologies and specific testing and sampling methods for each potentially injured resource, taking into consideration the DOI definitions of injury and the acceptance criteria for a determination of injury within each resource category. The injury definitions and the acceptance criteria are provided in the DOI regulations (43 CFR 11.62); and
- Determine the pathway by which the potentially injured resources have been exposed to oil or hazardous substances.

The DOI regulations provide for a process for collecting data on the effects of a discharge of oil or release of hazardous substances in the absence of any relevant existing data. In this case, relevant data have been collected. Because of the DOI regulations' emphasis on conducting a cost-effective assessment, the Trustees will use existing data to the extent consistent with generally accepted quality standards both to document injuries and to define and focus additional data collection efforts. The collection of new data will occur according to the procedures and requirements of the DOI regulations.

Injury determination is followed by quantification of the documented injuries. During the injury quantification stage, the Trustees evaluate the effect of the discharges or releases in terms of the reduction in the quantity and quality of natural resource services relative to the baseline level of services. The DOI regulations instruct the Trustees to take the following steps in completing the injury quantification phase of the assessment (43 CFR 11.70):

- Measure the spatial and temporal extent of the injuries documented in the injury determination phase;
- Estimate the baseline conditions of the injured resources;
- Identify the baseline services provided by the injured resources;

- Determine the recoverability of the injured resources; and

- Estimate the reduction in services relative to baseline resulting from the discharges or releases.

The reduction in services is the measure by which the Trustees determine, in the damage determination phase, both the appropriate course of action to restore injured resources to their baseline conditions and the magnitude of compensable values.

The following sections describe the specific activities the Trustees will undertake to determine and quantify injury to natural resources in the assessment area. The Trustees have developed this portion of the Assessment Plan (Plan) with the intention of achieving three objectives:

(1) Document the nature and scale of injuries to natural resources that are "indicators" of the broader range of potential injuries, such that the development of a comprehensive restoration plan is possible;

(2) Complete the injury assessment in the most cost-effective manner possible, balancing the need for clear and convincing documentation of injuries with the need for an expeditious assessment at a reasonable cost; and

(3) Satisfy the requirements for an injury assessment provided in the DOI regulations.

Regarding the third objective, any details concerning assessment activities that cannot be provided in this Plan will be documented in specific work plans that will be made available for public review as they are developed. This applies in particular to the collection and analysis of environmental samples from the assessment area. In order to bring the PRP community and the public into the assessment process as early as possible, this Plan has been developed in advance of the creation of detailed sampling plans (i.e., plans that include information such as sample numbers, locations, and physical and chemical analyses). The Assessment Plan may be modified at any stage of the assessment as new information becomes available (43 CFR 11.32(e)(1)).

Pathway Determination

The injury determination studies described below will help document that there are injury pathways that begin with sources of oil and hazardous substances, continue through various environmental media (i.e., ground water, surface water, sediments, and soils) and eventually reach biological resources such as aquatic invertebrates, freshwater mussels, and fish. To complement these studies, the Trustees expect to evaluate separately the first part of this pathway, from the sources of oil and hazardous substances to the environmental media where exposure occurs. This evaluation will be based on a review of available information documenting past and current operating and disposal practices, as well as information regarding regulatory enforcement actions, at the facilities located within the assessment area. This pathway analysis will also use existing information to assess the presence of contaminated sediments in the EBLCR, Burns Waterway, and Burns Harbor.

Injury Determination

The Trustees' approach to injury determination will be to document the impact of oil and hazardous substances on the resources of the assessment area by focusing on selected resources that represent key elements of the assessment area ecosystem. Specifically, the Trustees will examine:

- **Surface water** - the immediate receptor of oil and hazardous substances from point and non-point sources, and a medium in which biological resources are potentially exposed to oil and hazardous substances;

- **Sediments** - the medium in which many contaminants discharged or released to surface water come to be located, thus becoming a secondary source of contamination that results in the exposure of biological resources throughout the aquatic community;

- **Benthic invertebrates** - biological resources at the base of the food chain that are particularly susceptible to injury as a result of direct contact with contaminated sediments. Disruption or impairment of the invertebrate community might result in the impairment of higher-level organisms that depend on invertebrates for food (e.g., fish, birds);

- **Freshwater mussels** - biological resources that, as filter feeders, are especially sensitive to water quality impairments, and live in direct contact with contaminated sediments; and

- **Fish** - important biological resources in terms of both their position in the food chain and their relationship to human uses of the environment.

This section describes a series of tasks that together are expected to confirm injuries at these various levels of the assessment area ecosystem, thereby providing the basis for a damage claim comprising both primary restoration costs and appropriate compensable values. The following information is provided for each task:

- **Objective** - the specific purpose of the task in the context of the overall damage assessment;

- **Operative Injury Definition** - the relevant basis for injury as described in the DOI regulations;

- **Regulatory Conformance** - information the Trustees must consider in order to satisfy the requirements of the DOI regulations;

- **Background Information** - important facts that will guide the Trustees as they undertake the task; and

- **Approach** - a description of the specific steps the Trustees will take to complete the task.

The Trustees reserve the right to expand the assessment to include additional resources (e.g., other biological resources, such as birds and mammals). Specific tasks to evaluate additional injuries would be documented as modifications to this Assessment Plan, which would be made available for review by the PRPs and the interested public.

Task 1 - Evaluate Surface Water with Respect to Applicable Water Quality Criteria

Objective

Document injury to surface water (water column) resources and establish surface water as a link in the exposure pathway to other potentially injured resources.

Operative Injury Definition

Surface water injury has resulted from the discharge of oil or release of a hazardous substance if the Trustees can measure concentrations "in excess of applicable water quality criteria established by section 304(a)(1) of the CWA, or by other Federal or State laws or regulations that establish such criteria, in surface water that before the discharge or release met the criteria and is a committed use… as a habitat for aquatic life, water supply, or recreation" (43 CFR 11.62(b)(1)(iii)).

Regulatory Conformance

The acceptance criterion for injury to surface water is the measurement of concentrations of oil or a hazardous substance in two samples. If the samples are from the same medium they must be from different locations separated by a straight line distance of not less than 100 feet, or, in the case of water samples, from the same location but collected at different times (43 CFR 11.62(b)(2)(i)). In evaluating existing data, the Trustees will provide documentation that previously collected samples satisfy this criterion. The Trustees will also provide documentation showing that existing data are the result of sample collection and analysis that was conducted using generally accepted methods (43 CFR 11.64(b)(2) and (4)).

Background Information

Water quality standards for Indiana surface waters are established by the Environmental Rules Board (Board). In March 1990, the Board adopted new water quality standards for Lake Michigan and the EBLCR and Burns Waterway that are consistent with the CWA goal of water quality that provides for the protection of fish, shellfish, wildlife, and recreation in and on the water. The new standards, which include numerical criteria for approximately 90 pollutants, upgraded the EBLCR and Burns Waterway to the same aquatic life and recreational uses as other warm water streams in Indiana. The Board adopted the standards not only to protect and enhance the waters of the EBLCR and Burns Waterway but also to protect the uses and quality of Lake Michigan waters (IDEM 2018, 2020).

Approach

IDEM and AMBH have collected surface water data from the EBLCR and Burns Waterway through routine water quality monitoring. In this task, the Trustees will compare observed concentrations to existing water quality criteria. The analysis is expected to be conducted using a geographic information system (GIS) in order to more easily illustrate spatial relationships. Data will be adjusted, as necessary, to provide direct comparability with criteria that incorporate measures of specific physical parameters (e.g., pH, temperature, hardness).

Task 2 - Characterize the Nature and Extent of Soil and Sediment Contamination

Objective

Document contaminant concentrations in the soils and sediments of the EBLCR, Burns Waterway, Burns Harbor, and associated off-river habitats (e.g., wetlands); establish the sediment link in the pathway between contaminant sources and biological resources; and provide the data necessary for the eventual formulation of an appropriate restoration plan.

Operative Injury Definition

An injury to a surface water resource has resulted from the discharge of oil or release of a hazardous substance if the Trustees can measure concentrations of substances in suspended, bed, bank, shoreline sediments or sediment pore water sufficient to have caused injury to biological resources (43 CFR 11.62(b)(1)(v)). Similarly, geologic resources (e.g., wetland soils) are injured if they contain concentrations of substances sufficient to cause injury to other resources (e.g., surface water, ground water, biological). The DOI regulations also provide ten specific measures of injury to geologic resources, including concentrations of substances sufficient to: raise soil pH above 8.5 or lower it below 4.0; impede soil microbial respiration; cause a toxic response in soil invertebrates; and/or cause a phytotoxic response, such as retardation of plant growth (43 CFR 11.62(e)).

Regulatory Conformance

The acceptance criterion for injury to the sediment portion of surface water resources is the measurement of concentrations of oil or a hazardous substance in two samples from different locations separated by a straight-line distance of not less than 100 feet (43 CFR 1.62(b)(2)(i)(B)). In evaluating existing data and collecting new data, the Trustees will provide documentation showing that this criterion has been satisfied. The Trustees will also provide documentation showing that existing data and new data are the result of sample collection and analysis conducted using generally accepted methods (43 CFR 11.64(b)(2) and (4)). No acceptance criteria are provided for injury to geologic resources in the DOI regulations.

Background Information

As noted in Chapter 2, sediments in the assessment area have been sampled and analyzed on several occasions over the past 20 years. In light of this potentially useful data, the Trustees' goal is only to identify and fill significant data gaps. In order to accomplish this goal, the Trustees propose to undertake the phased approach described below.

Approach

<u>Review of existing data</u>

The Trustees will review the data associated with sampling and analysis efforts from previous studies. These studies provide significant coverage of the assessment area for sediment chemistry. However, as these studies were not prepared in a NRDA context, it is necessary for the Trustees to confirm that they provide data that are acceptable for such a purpose. If the data are judged to have been obtained in accordance with standard quality assurance procedures, the Trustees will proceed to collect additional data only from portions of the river, waterway, and harbor that have not already been sufficiently characterized (as defined in the following step).

<u>Data gap analysis</u>

Following the review of existing data, the Trustees will undertake a detailed analysis of the geology and hydrology of the EBLCR and Burns Waterway environment in order to identify those areas for which existing data do not provide adequate characterization. In particular, the Trustees will consider variations in factors such as depositional environments and sediment characteristics along the river, waterway, and harbor as a means of assessing whether significant differences in contaminant concentrations could be expected between locations at which samples were collected during previous studies.

The Trustees will also survey and characterize the riverine and upland habitats associated with the river as a step toward identifying and prioritizing off-river sampling locations. The focus of this effort will be on wetlands associated with the river that may be contaminated. In order to develop a comprehensive restoration plan, the Trustees require additional information on these important components of the assessment area ecosystem. In accomplishing this sub-task, the Trustees will seek only to build on existing, reliable data that may be available.

Additional sampling and analysis

As described earlier in this chapter, the Trustees plan to develop and make available for public review detailed sampling plans prior to the commencement of environmental sampling activities. The Trustees anticipate collecting sediment samples from "mid-stream" of the bed of the EBLCR and Burns Waterway (i.e., between their respective banks). At a minimum, the Trustees will address the following issues during the development of study plans for the collection and analysis of sediments and soils:

- The appropriate **type of samples** within each study area (i.e., samples from discrete points ("grab" sampling) or combinations of samples from multiple points ("composite" sampling));

- The **number of samples** from each study area that will be sufficient to provide a complete characterization of the area;

- The **locations of samples** within each study area that will be sufficient to provide a complete characterization of the area;

- The **depth of each sample** such that results will sufficiently document the nature and extent of contamination in each study area; and

- The **scope of the chemical analysis** for each set of samples. At a minimum, the Trustees will analyze sediment and soil samples for the primary contaminants of concern (ammonia-nitrogen, oil-related compounds [e.g., TPH], and metals) using standard analytical protocols established by the USEPA. The Trustees may also analyze samples for the presence of additional hazardous substances (e.g., PAHs).

Each sample location will be accurately recorded (for example, with global positioning system technology), as will the physical characteristics (color, grain size, etc.) of each sample.

Task 3 - Evaluate the Impact of Sediment Contamination on Invertebrate Communities

Objective

Document injury to two resource categories: sediments (by demonstrating that they are injurious to other resources) and the invertebrate community (thus documenting the impairment of an important link in the assessment area food chain).

Operative Injury Definition

As noted above, an injury to a surface water resource has resulted from the discharge of oil or release of a hazardous substance if the Trustees can measure concentrations of substances in suspended, bed, bank, or shoreline sediments sufficient to have caused injury to biological resources. In general, an injury to invertebrates, a biological resource, has occurred if concentrations of discharged oil or released hazardous substances are sufficient to cause the invertebrates or their offspring to have undergone at least one of the following adverse changes in viability: death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations (43 CFR 11.62(f)(1)(i)).

Regulatory Conformance

The DOI regulations describe four acceptance criteria for demonstrating injuries to biological resources in general:

(1) The biological response (i.e., the injury) is often the result of exposure to oil or hazardous substances;

(2) Exposure to oil or hazardous substances is known to cause this biological response in free-ranging organisms;

(3) Exposure to oil or hazardous substances is known to cause this biological response in controlled experiments; and

(4) The biological response measurement is practical to perform and produces scientifically valid results.

Eighteen different biological responses in six categories of injury have, by rule, been determined to meet the acceptance criteria (43 CFR 11.62(f)(4)). These responses are listed in Table 3-1. The Trustees will use these responses to document injury whenever possible; other responses that satisfy the acceptance criteria will be measured as necessary.

Background Information

Limited data from the EBLCR and Burns Waterway system has indicated a depauperate benthic invertebrate community. Eighteen different species of freshwater mussels were historically found in this watershed (Charles Morris, personal comm.). There are many different possible explanations as to why only two different mussel species are still found in this watershed. We are unaware of any sediment quality data from this system that would help us understand potential impacts to, or limitations on, the macroinvertebrate community of the EBLCR. Our assessment activities to address these data gaps are described below.

Table 3-1: Biological Responses for Determining Injury that Satisfy the DOI Acceptance Criteria (43 CFR 11.62(f)(4))

Injury Category	Response
Death	Brain cholinesterase (ChE) activity Fish kills Wildlife kills In situ bioassay Laboratory toxicity testing
Disease	Fin erosion
Behavioral abnormalities	Clinical behavioral signs of toxicity Avoidance
Cancer	Fish neoplasms
Physiological malfunctions	Eggshell thinning Reduced avian reproduction Cholinesterase (ChE) enzyme inhibition Delta-aminolevulinic acid dehydrase (ALAD) inhibition Reduced fish reproduction
Physical deformation	Overt external malformations Skeletal deformities Internal whole organ and soft tissue malformation Histopathological lesions

Approach

As part of the sediment characterization effort, the Trustees will collect samples (Fig. 2-1) to use in testing the toxicity of the sediments to benthic invertebrate species. Selected species will be exposed to both EBLCR and Burns Waterway sediments and suitable control sediments. As noted above, laboratory toxicity testing is an accepted way to measure death (i.e., mortality) as a biological response to hazardous substances. One category of injury is documented if the Trustees measure a statistically significant difference in total mortality or mortality rates between population samples in exposure chambers and population samples in control chambers (43 CFR 11.62(f)(4)(i)(E)).

The objective of a sediment toxicity test is to determine whether contaminants in sediment are injurious to benthic organisms. The tests can be used to measure interactive toxic effects of complex contaminant mixtures in sediment. Toxicity is determined by measuring a statistically significant increase in mortality (or other endpoint) in the exposed population relative to that measured in a control population. The analysis would follow a standard USEPA protocol (USEPA 1994) by exposing surrogate test species (*Hyalella azteca* and/or *Chironomus dilutus*) to the sediment.

We also propose a 28-day juvenile mussel (*Lampsilis siliquoidea* or another native mussel) bioassay with ammonia and cyanide to follow after the results of the *H. azteca* and *C. dilutus* toxicity tests are known. These mussel bioassays will be water only studies to determine the toxicity of two chemicals, ammonia and cyanide (or other chemicals), using a freshwater mussel. While there is some toxicity data for ammonia in mussels, there is limited data for cyanide (Pandolfo et al. 2012), and we do not know of any toxicity data available for native mussel species at the site (Wang et al. 2007). This task is to propagate and use a species of mussel from the EBLCR and determine toxicity to selected chemicals of concern. Methods will employ the 28-day juvenile mussel bioassay that has demonstrated sensitivity to a wide range of chemical contaminants (Wang et al. 2018a; Wang et al. 2018b).

At a minimum, the Trustees will address the following issues during the development of sampling plans for the collection and toxicity analysis of sediments:

- The appropriate **type of samples** within each study area (i.e., samples from discrete points ("grab" sampling) or combinations of samples from multiple points ("composite" sampling));

- The **number of samples** from each study area that will be sufficient to provide a complete characterization of the area;

- The **locations of samples** within each study area that will be sufficient to provide a complete characterization of the area; and

- The **depth of each sample** such that results will sufficiently document the nature and extent of contamination in each study area.

Task 4 - Evaluate the impact of oil and hazardous substances on fish populations

Objective

Document injury to fish populations in the EBLCR and Burns Waterway and further document the disruption of the assessment area ecosystem caused by the presence of oil and hazardous substances.

Operative Injury Definition

An injury to fish has occurred if concentrations of discharged oil or released hazardous substances are sufficient to:

> Cause the biological resource or its offspring to have undergone at least one of the following adverse changes in viability: death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations (43 CFR 11.62(f)(1)(i)).

Regulatory Conformance

See the description under Task 3 for information on relevant portions of the DOI regulations governing the determination of injuries to biological resources.

Background Information

Injury to fish is established without further assessment as a result of fish die-offs in the EBLCR and Burns Waterway. In addition, fish species diversity appears to have been reduced in the EBLCR and Burns Waterway when compared to the biological integrity expected in tributaries to the Great Lakes in the "central corn belt plain" ecoregion (Meek and Hildebrand 1910, Gerking 1945, Simon et al. 1988). The inability of the EBLCR and Burns Waterway to support and maintain biological integrity as defined in Karr and Dudley (1981) is potentially due to poor water quality causing impaired reproduction and death of pollution intolerant fish species in the assessment area.

The purpose of undertaking an additional assessment of injury to fish is to document the impact of oil and hazardous substances on the organisms themselves. A better understanding of this impact will guide the Trustees in developing an appropriate restoration plan aimed at restoring the health and natural diversity of the EBLCR and Burns Waterway fish community to baseline conditions.

Approach

For the purpose of this assessment, the Trustees will undertake an investigation of the fish community structure in the EBLCR and Burns Waterway. The Trustees will also document the frequency of external ailments, including: external malformations, skeletal deformities, and lesions (43 CFR 11.62(f)(4)(vi)(A,B-D)).

The Trustees will supplement this original assessment of the impact of contaminants on fish with a comprehensive literature review. The purpose of this review will be to compare the results of our site-specific studies to results that have been reported previously. The Trustees expect that such a review will confirm that effects observed in the assessment area are comparable to effects observed in other systems with similar levels of contamination. The Trustees may retain the services of an expert in the field of aquatic toxicology to perform this review.

Injury Quantification

The DOI regulations state that the specific resources or services to quantify and the methodology for doing so should be based upon the following factors:

(1) The degree to which a particular resource or service is affected by the discharge or release;

(2) The degree to which a given resource or service can be used to represent a broad range of related resources and services;

(3) Consistency of the measurement with the requirements of the economic methodology to be used in the damage determination phase;

(4) The technical feasibility of quantifying changes in a given resource or service at reasonable cost; and

(5) Preliminary estimates of services at the assessment area and control area based on resource inventory techniques (43 CFR 11.71(d)).

The regulations list a variety of natural resource services that Trustees may choose to quantify, including but not limited to: provision of habitat, food and other needs of biological resources; recreation; other products or services used by humans; flood control; ground water recharge; and waste assimilation (43 CFR 11.71(e)).

Considering the five factors listed above, the Trustees have determined that injury quantification in this case is best served by focusing on two important services provided by the potentially injured resources: the loss or impairment of surface water and sediment (including wetland areas characterized as geologic resources) as habitat for biological resources, and the loss or impairment of recreational opportunities, including recreational fishing and lost human use of beaches. The latter service includes the human uses of injured biological and surface water / geologic (e.g., beaches) resources, consistent with the second factor listed above.

The DOI regulations describe two general approaches for quantifying injuries to natural resources and their services. The first, which the Trustees will employ to quantify surface water and sediment injury, involves the measurement of the scale of the injury itself. The Trustees will document the geographic area in which surface water and sediment have been injured and will then document the extent to which natural resources and their services in this area have been reduced from their baseline condition. The second approach, which the Trustees will employ to quantify lost recreational opportunities, including lost human use of beaches and recreational fishing, is the direct quantification of services. As described at 43 CFR 11.71(f), direct quantification of services is appropriate if the following conditions are met:

(1) The change in the services from baseline can be demonstrated to have resulted from the injury to the natural resource (e.g., lost visitor use opportunities due to the temporary closure to public use of the NPS Portage Lakefront and Riverwalk beach area and portions of the EBLCR that flow through INDU was a direct result of the visible fish kill in the area);

(2) The extent of the change in the services resulting from the injury can be measured without also calculating the extent of change in the resource (e.g., measuring the loss of fishing opportunities does not depend on the measurement of physical changes in fish); and

(3) The services to be measured are anticipated to provide a better indication of damages caused by the injury than would direct quantification of the injury itself.

The first condition is met due to the existence of the August 2019 fish kill in the EBLCR and Burns Waterway. The second condition is met because the Trustees routinely documented the "fishing pressure," or use of the EBLCR and Burns Waterway prior to the August 2019 fish kill, through comparisons to use levels through creel surveys (interviews with local anglers and resource managers). The third condition is met because the value of the potentially injured biological and surface water / geologic resources is attributable largely to the human use of those resources. Therefore, measurement of lost human uses allows a quantification of damages associated with injury to fish populations and beach habitat. As noted above, the quantification of particular injuries to natural resources, including fish and beach habitat, is described more fully herein.

Quantification of Lost Human Uses of Recreational Resources

Two types of lost recreational uses occurred as a result of the spill: beach closures resulted in fewer INDU visitor opportunities, and the closure of the EBLCR and Burns Waterway resulted in the loss of recreational fishing opportunities.

Lost use of Public Beaches

The public lost access to portions of Indiana Dunes National Park for a week during the summer peak visitation season. Portage Lakefront and Riverwalk Beach, located on the west side of the Burns Waterway, is used by around 14% of all Park visitors (Holmes et al., 2010). The closest substitute public beach, managed by the city of Ogden Dunes, was also closed as a result of the spill.

To determine the number of INDU visitors affected by the closure of Portage Lakefront and Riverwalk Beach, the Trustees reviewed all official visitation data maintained by NPS' Visitor Use Statistics Office and consulted with INDU staff to identify any additional sources of visitation data. INDU maintains an inductive loop traffic counter at the entrance to Portage Lakefront and Riverwalk, which captures the majority of visitation to this beach area. The Trustees reviewed the traffic counter data to determine the number of vehicles entering the beach on a daily basis in August of 2019. This count is divided by two to adjust for entering and exiting vehicles, reduced for non-reportable (NREP) vehicles, and multiplied by a persons-per-vehicle (PPV) multiplier of 3.1 to convert vehicles to the number of visitors using the beach (NPS Stats, 2020). From these August 2019 records, INDU knows the number of visitors per day recreating at Portage Lakefront and Riverwalk when the beach was open to the public. The closure lasted approximately 6.5 days, resulting in a quantifiable number of visitor-days lost as a direct result of the spill.

The net economic value per visitor-day for this analysis can be determined through a travel cost analysis of visitor survey data from Indiana Dunes National Park (Holmes et al., 2010). The travel cost method, a revealed preference approach, is well-accepted for use in natural resource damage assessments (43 C.F.R. § 11.83), and has been used frequently to determine the value of recreational opportunities in national parks (e.g., Heberling and Templeton, 2009; Melstrom, 2013; Richardson et al., 2017) and other public lands (see Rosenberger, 2016 for a summary). A demand function is estimated that relates the number of trips to the recreation site over the past 12 months to the price of access to the site, including travel costs and the opportunity cost of time (Parsons, 2017).

Lost Recreational Fishing

IDNR has conducted creel surveys each year at four Lake Michigan access points in Northern Indiana between April 1st and October 31st since 2007. These creel surveys were designed to provide estimates of angler effort along Lake Michigan in Indiana. IDNR utilized the data from the creel surveys in 2019 to evaluate lost recreational fishing and boating uses in the spill zone.

IDNR modeled shore counts using generalized linear mixed models (Zuur *et al*. 2009). Variables considered in the model include random effect for year, month of the year, time of day, weather (daily temperature, wind speed, and precipitation) and weekends versus weekdays. These same general procedures were used to model boat counts. To estimate the reduction in angler counts in the post-spill period, we calculated the percent difference between the predicted counts and the actual counts and averaged that value across all dates. These declines were calculated separately for shore angler and boat angler counts and these average values were used to estimate the total economic value lost in the post-spill period. The specific details of how these calculations were performed are discussed below.

IDNR calculated shore angler and boat angler predicted counts for every date in the post-spill period and reduced those by the average decline to calculate the reduced shore angler and boat angler counts. We multiplied these by 14 hours (the approximate number of daytime fishing hours available, per our creel program) to get average predicted and reduced daily angler hours and boat counts. We divided these values by average trip hours (2.9 for shore and 5.2 for boat, per our creel program) to calculate predicted and reduced trips per day. To estimate the predicted and reduced trip value, we multiplied average trips per day by a value of $29.14/day for shore angling trips and $32.24/day for Indiana boat angling trips. These values were calculated using the estimated value for shore and boat angling trips in 2015 (Zischke and Gramig, 2017). These costs will be adjusted for inflation to 2021 dollars. We defined total lost economic value as the total difference between predicted and reduced value.

Quantification of Injuries to Surface Water and Geologic Resources

As described herein, the steps in the injury quantification process include measuring the extent of injuries, estimating baseline conditions and services, determining resource recoverability, and estimating the service reduction. The Trustees' approach to each of these steps is described below for the quantification of injuries to surface water and geologic resources, including the surface waters and sediments that provide habitat for biological resources.

Extent of Injury

To document the extent of surface water injury, the Trustees will generate a detailed map of the assessment area depicting those areas where concentrations of oil or hazardous substances in surface water, sediments, and/or soils are sufficient to have injured the resource or to have caused injury to other resources. As described in the DOI regulations, the Trustees should measure areal variation in concentrations "in sufficient detail to approximately map the boundary separating areas with concentrations above baseline from areas with concentrations equal to or less than baseline" (43 CFR 11.71(h)(2)(i)). The Trustees will complete a similar exercise for those resources characterized as geologic (e.g., wetland soils), documenting the surface area of soils with reduced suitability as habitat for biota relative to baseline (43 CFR 11.71(k)(2)).

Baseline Services Determination

As noted in Chapter 1, "baseline" is the condition or conditions that would have existed in the assessment area had discharges of oil or releases of hazardous substances under investigation not occurred. The baseline services are those services that would have been provided by injured resources but for the discharges of oil or releases of hazardous substances. Whenever possible, the baseline level of services should be based upon historical data. If appropriate historical data are not available, the Trustees should, if possible, collect baseline data from reference (or "control") locations that are as similar to the assessment area as possible in all respects other than the discharge of oil or release of hazardous substances.

In their baseline condition, sediments and soils provided a particular quantity and quality of habitat for biological resources. The Trustees will use historical data from the assessment area and, if possible, from suitable reference locations, to make a reasonable determination of the baseline habitat quantity and quality for biological resources relative to ArcelorMittal's August 2019 hazardous substance releases. Furthermore, by Indiana code (327 IAC 2-1.5-5), the EBLCR is designated for multiple uses of "full-body contact recreation" and "shall be capable of supporting a well-balanced, warm water aquatic community." In addition, the EBLCR and its tributaries downstream to Lake Michigan via Burns Waterway are designated as salmonid waters and shall be capable of supporting a salmonid fishery." Finally, All waters incorporated in the Indiana Dunes National Lakeshore (now Park) are also identified as outstanding state resource waters (327 IAC 2-1.5-19).

The Trustees recognize that it will be a challenge to establish a concrete "baseline" condition for resource services. However, the Trustees may use substitute baseline data instead of completely measuring baseline conditions, subject to the Trustees' ability to document that:

- Substitute baseline data shall not cause the difference between baseline and the conditions in the assessment area to exceed the difference that would be expected if the baseline were completely measured; and
- It is either not technically feasible or not cost-effective to measure the baseline conditions fully and that these baseline data are as close to the actual baseline conditions as can be obtained subject to these limitations (43 CFR 11.72(b)(5)).

The Trustees believe that, for the purpose of this assessment, the use of "substitute" baseline data will not result in an overestimate of resource injuries and will be more cost-effective than attempting to fully measure baseline conditions of injured resources and their associated services.

Resource Recoverability Analysis

The Trustees note that habitat quality in the assessment area has been generally good, scoring 51 or above in QHEI scores over the past decade (IDEM undated). Although biological studies have documented a gradual shift from more- to less-pollution tolerant fish and invertebrate species in the EBLCR and Burns Waterway over the past decade, there still appears to be a lower diversity and relative abundance of biota present (Morris and Simon 2011). A better understanding of current conditions of surface water, sediments, and soils in the assessment area will inform us how a return to their baseline conditions might come about.

As part of the injury quantification process, Trustees are required to estimate the time needed for injured resources to recover to their baseline condition, both without restoration efforts beyond planned or ongoing response activities, and with proposed restoration alternatives. Since the Trustees have not yet completed an assessment of injuries and have not yet developed specific restoration alternatives, it is not possible to undertake this analysis at this time. The Trustees will incorporate this analysis into the development of restoration alternatives and the completion of restoration plan.

Service Reduction Quantification

The Trustees will quantify the reduction in services by measuring the area of those habitats that have been degraded relative to their baseline condition. If data are available to document ecological service losses that would have occurred absent discharges of oil and releases of hazardous substances, then the measure of lost ecological services may be a function of the acreage of sediment and soil habitat in which oil and hazardous substances are detected.

Quantification of Injuries to Biological Resources

As described above, the Trustees will quantify injuries to biological resources through the direct measurement of the spatial extent and the degree of toxicity to macroinvertebrates and mussels. We will also compare diversity and abundance of macroinvertebrates with the results of the toxicity evaluations. We will also conduct a REA using the fish kill data we collected in August 2019.

Baseline Services Determination

As with surface water and geologic resources, the Trustees will rely on available historical data from the assessment area and suitable reference locations in the same ecoregion for interpreting IBI (Ohio EPA 1989a, Simon 1991) and mIBI results (IDEM 2010) from the assessment area.

Resource Recoverability Analysis

Since the Trustees have not yet completed an assessment of, and have not yet developed, specific restoration alternatives, it is not possible to undertake a resource recoverability analysis at this time. The Trustees will incorporate this analysis into the development of restoration alternatives and the completion of restoration plan. The Trustees do note, however, that the recoverability of the EBLCR and Burns Waterway as a source of recreational services will track closely with, and be dependent upon, the recovery of both aquatic and terrestrial habitats.

Service Reduction Quantification

The Trustees will quantify the reduction in ecosystem services as the difference between the best achievable conditions of the EBLCR and Burns Waterway with and without the discharge of oil and release of hazardous substances. The Trustees believe that the direct quantification of the fish mortality incident along with any additional reduction in fish diversity and abundance will augment data on the impairment of surface water and sediment as habitat for biological resources. Any double counting of lost services will be eliminated in the damage determination and restoration planning phase of the assessment (see 43 CFR 11.83(a)(3)(iii)).

Introduction

In the damage determination phase, the Trustees determine the type and magnitude of compensation required to restore injured natural resources to the appropriate baseline condition and to address the public's loss of natural resource services from the time of the injury until full recovery to baseline (the "interim loss"). The DOI regulations define two measures of compensation: the cost of restoration (i.e., restoration, rehabilitation, replacement, and/or acquisition of the equivalent), and the monetary value (the "compensable value") of the interim loss. Trustees are precluded from considering compensable value damages that are based on purely speculative uses of injured resources in their baseline condition ("only committed uses of the resource or services over the recovery period will be used to measure the change from the baseline" and "the baseline uses must be reasonably probable, not just in the realm of possibility") (43 CFR 11.84(b)(2)).

Implementation of the damage determination phase is dependent upon completion of a Restoration and Compensation Determination Plan (RCDP). The RCDP lists a range of restoration alternatives, includes the selection of one alternative and the rationale supporting that selection, identifies the methodologies the Trustees will use to determine the costs of the selected alternative, and identifies the methodologies the Trustees will use to determine compensable values. The RCDP is to be of sufficient detail to evaluate the alternatives and select the one that is most appropriate (using specific criteria described in this chapter).

Existing data are not sufficient to develop the RCDP concurrently with the Assessment Plan for EBLCR and Burns Waterway. Accordingly, the RCDP development for this case is dependent on completion of the injury determination and quantification phase. The RCDP for this case will be made available for a separate public review, as appropriate. Nevertheless, this chapter is intended to provide the PRPs and the public with a clear sense of the anticipated nature and scope of the damage determination.

Baseline

Chapter 3 described the Trustees' approach to baseline in the context of quantifying lost natural resources and their services, which is an essential component in the calculation of compensable values. The Trustees must also consider baseline in the context of restoration. Specifically, the Trustees must be prepared to describe the conditions (i.e., the baseline) that they seek to restore. As stated in the DOI regulations, baseline, in general,

> "should reflect conditions that would have been expected at the assessment area had the discharge of oil or release of hazardous substances not occurred, taking into account both natural processes and those that are the result of human activities" (43 CFR 11.72(b)(1)).

In its baseline condition, the EBLCR is designated for multiple uses of "full-body contact recreation" and "shall be capable of supporting a well-balanced, warm water aquatic community" (327 IAC 2-1.5-5). In addition, the EBLCR and its tributaries downstream to Lake Michigan via Burns Waterway are designated as salmonid waters and shall be capable of supporting a salmonid fishery." Finally, All waters incorporated in the Indiana Dunes National Lakeshore (now Park) are also identified as outstanding state resource waters (327 IAC 2-1.5-19). Therefore, impacts on natural resources should not be aggravated or amplified by the introduction of unpermitted oil and hazardous substances. Accordingly, baseline for surface water, sediment and soil in the EBLCR and Burns Waterway assessment area is affected by the accidental or unpermitted discharges of oil or releases of hazardous substances. Such discharges or releases can impair the use of the areas as habitat for biological resources. In its baseline condition, the EBLCR and Burns Waterway would also not be subject to die-offs of fish or loss of resource services (such as beach closures) due to the presence of oil or hazardous substances.

Restoration

The process of selecting a restoration alternative begins with the identification of a reasonable number of potential alternatives, each of which may include one or more specific actions designed to achieve restoration, rehabilitation, replacement, or acquisition of equivalent resources. Restoration and rehabilitation involve actions that return injured resources to their baseline condition (i.e., the physical, chemical, or biological properties that the injured resources would have exhibited or the services that would have been provided by the resources had the discharges of oil or releases of hazardous substances not occurred). Both replacement and acquisition of equivalent resources involve using other resources as a substitute for the injured resources because the substitute resources provide the same or substantially similar services. The Trustees must compare the range of action alternatives to a "no action-natural recovery" alternative, which involves minimal management of injured resources beyond actual or planned response actions. The Trustees will base the selection of a restoration alternative upon the careful consideration of each alternative with respect to the following ten factors, at a minimum:

(1) Technical feasibility;

(2) The relationship of the expected costs of the proposed actions to the expected benefits of restoration;

(3) Cost-effectiveness;

(4) The results of any actual or planned response actions;

(5) Potential for additional injury resulting from the proposed actions, including long-term and indirect impacts, to the injured resources or other resources;

(6) The natural recovery period;

(7) Ability of the resources to recover with or without alternative actions;

(8) Potential effects of the action on human health and safety;

(9) Consistency with relevant federal, state, and tribal policies; and

(10) Compliance with applicable federal, state, and tribal laws (43 CFR 11.82(d)).

The next two sections describe the Trustees' general restoration objectives for the assessment area and the types of actions the Trustees are likely to consider when developing a comprehensive restoration plan. Both the objectives and the potential alternatives are subject to change, pending completion of the injury assessment.

Restoration Objectives

The Trustees' goal is to restore resources in the assessment area to their baseline condition and to compensate the public for the interim loss of those resources and their services. Further, restoration goals for the EBLCR, Burns Waterway, and associated habitats include supporting viable and sustainable populations of fish, wildlife, and other aquatic species. With these general goals in mind, the Trustees hope to achieve the following restoration and post-restoration objectives:

1. Address sources of contamination - As part of the restoration of resources in the assessment area, the Trustees expect to address sources of contamination that have not been, and are not expected to be, addressed through other regulatory mechanisms (e.g., RCRA Corrective Action). Restoration of natural resources will not be successful without elimination of continuing, injurious discharges and releases. As described in Chapter 1, the Trustees' intention is to work cooperatively with federal and state agencies to coordinate restoration activities with other actions designed to address contamination issues in the assessment area. Specifically, the Trustees' objective is to address sources of contamination to the EBLCR, Burns Waterway and INDU, and to address the release of contaminants from the EBLCR and Burns Waterway to Lake Michigan.

2. Minimize collateral injury during restoration - Any time physical restoration of natural resources is undertaken, there is a possibility that the restoration actions themselves will have unavoidable adverse impacts on the environment. For example, the removal of sediments from a river may require the use of heavy equipment on the riverbank and the disturbance of riverbank habitat. As noted above, one of the criteria the Trustees will use to evaluate restoration alternatives is the potential for additional injury resulting from the proposed actions. In light of this criterion, the Trustees will seek to minimize the occurrence of such collateral injuries. When developing the RCDP, the Trustees will consider, and potentially seek compensation for, unavoidable impacts that constitute injury to natural resources as a result of restoration actions.

3. <u>Restore lost and diminished functions of the assessment area ecosystem</u> - A number of factors are associated with the general goal of restoring the ability of the EBLCR, Burns Waterway, and associated habitats to support viable and sustainable populations of fish, wildlife, and other aquatic species. These include improving water quality, improving the quality of bed and bank sediments, and improving the quality of wetlands associated with the EBLCR and Burns Waterway. In selecting a restoration alternative, the Trustees' will be seeking a set of actions that achieves these objectives in a coordinated and cost-effective manner.

4. <u>Restore lost and diminished human uses of assessment area resources</u> - The evaluation of injuries and damages associated with lost human use of assessment area resources focuses on recreational fishing and other recreational uses of INDU, including lost visitor use. The Trustees' objective is to restore the ability for the EBLCR, Burns Waterway and associated habitats to support a variety of consumptive and non-consumptive uses, including boating, wildlife viewing, beach use, and public education.

5. <u>Restore public trust in the river</u> - The assessment area as a whole is an important resource for northwest Indiana in terms of both its contribution to the local landscape and its influence on the valuable resources of Lake Michigan. By undertaking restoration activities, the Trustees hope to achieve the objective of restoring the public's confidence in the quality of the assessment area's resources.

Potential Restoration Alternatives

As noted above, the Trustees do not yet have sufficient information to develop specific restoration alternatives for the assessment area. However, the types of activities that might be appropriate for addressing water quality impairments of the EBLCR and Burns Waterway might include stream restoration or enhancement, rebuilding the fish community through stocking, and/or mussel augmentation and propagation efforts, and improving access and recreational use for visitors and anglers. It may be desirable to use a combination of activities to accomplish restoration objectives in the most cost-effective manner possible.

The Trustees will also consider alternatives in order to achieve restoration in the most cost-effective manner possible. These alternatives could include actions to improve the condition of natural resources (e.g., controlling the continued release of oil or hazardous substances), as well as actions that fall in the categories of replacing or acquiring equivalent resources to those that have been injured.

<u>Compensable Values</u>

Presented below are four areas in which the Trustees believe the estimation of compensable values may be appropriate. The Trustees will continue to evaluate options for compensable value calculations during the period leading up to completion of the RCDP and may add to, or subtract from, this compensable value analysis based on new information.

Compensable values are traditionally reported in monetary terms, and the use of these recovered monies is addressed in the restoration plan, which is generally developed in the post-assessment phase of a NRDAR case. It is the Trustees' intention to address the planned use of compensable value damages earlier in the process, as part of the RCDP, to the extent possible..

Compensation for the Interim Loss of Recreational Use at Indiana Dunes National Park

Releases of hazardous substances and the resulting fish kill lead to the closure of beaches and waterways to the public. The compensable value analysis for lost recreational use at INDU during the August 2019 closure will involve estimation of a travel cost model. The travel cost method is a revealed preference approach to non-market valuation, defined in the DOI regulations as using "an individual's incremental travel costs to an area to model the economic value of the services of that area" (43 CFR 11.83(c)(2)(iv)). The analysis will involve the following steps:

1. Evaluation of the loss in recreational use (e.g., visitor use of beaches) at Indiana Dunes National Park during the week-long closure;

2. Estimation of a travel cost model using previously collected visitor survey data to determine the loss per visitor-day; and

3. Application of the estimated value estimate to determine the compensable value of lost visitor use. The Trustees will multiply a measure of lost use (e.g., "visitor-days") by the loss per visitor-day.

Compensation for the Interim Loss of Recreational Fishing Opportunities

The compensable value analysis for recreational fishing losses will involve the application of the "unit value" methodology, which is defined in the DOI regulations as the application of "preassigned dollar values for various types of non-market recreational or other experiences by the public" (43 CFR 11.83(c)(2)). While the regulations encourage the use of region-specific values and values that "closely resemble the recreational or other experience lost," natural resource Trustees have interpreted this methodology to incorporate all forms of "benefits transfer." Benefits transfer involves the application of existing values, data, or models to a new valuation problem. Similar to the approach for evaluating baseline conditions, this approach will involve the broad-based collection and review of existing recreational (i.e., fishing) benefits literature, with an emphasis on region-specific data. Specifically, this analysis involves the following steps:

1. Full characterization of the nature of the lost fishing opportunities, including consideration of factors such as the wording of fish consumption advisories and the time period over which these advisories have been in effect;

2. A review of the economic and recreation literature to identify existing and relevant value estimates, data, and models; and

3. Application of the available value estimates, data, and models within a benefits transfer framework. In other words, the Trustees will multiply the measure of lost use (e.g., "angler days") by an appropriate unit value for that use (e.g., $/day) over a specified time period and will then calculate a present value over the time period for which the loss has been or will be incurred.

The Trustees may also conduct limited on-site interviews and/or focus groups with local anglers and resource managers to provide additional documentation for the values applied in the benefits transfer exercise. The Trustees do not anticipate undertaking an original study (e.g., developing a travel cost model) to evaluate the impact of resource injury on recreational angler behavior.

Compensation for the Interim Loss of Natural Resource Services

Replacement services are the restoration activities that will be implemented and are designed to compensate for interim losses, i.e. the time it takes for the natural resources to be fully recovered. It is important to understand that this compensation is in addition to the primary restoration measures that are required to restore the injured natural resource to its baseline. The Trustees plan to determine the amount of compensation that may be due using either a habitat equivalency approach, a resource equivalency approach, or possibly both.

The habitat equivalency approach (also referred to as a HEA) is an appropriate methodology for determining the necessary scale of compensation based on restoration, or the acquisition of equivalent resources, such as land. The basic premise of this approach is that the public can be compensated for interim service losses through the provision of additional services of the same type in the future. The unique aspect of equivalency approaches such as HEA is that the measure of compensable values is not dollars, but the diminished service itself. For example, the measure of compensable values can be expressed in terms of wetland (or other habitat) acres. These values are used to scale appropriate projects that will restore the equivalent amount of wetland acres that were injured.

The resource equivalency approach (also referred to as a REA) is conceptually similar to the habitat equivalency approach, and may be an appropriate methodology for determining the necessary scale of compensation based on restoration, or the acquisition of equivalent resources when the injury can be quantified in terms of individual organisms lost. For example, in an analysis where the injured resources are fish, the measure of compensable values would be expressed in terms of fish-years (a fish-year represents the services that would be provided by a single fish over the course of one year of its life). These compensable values are used to scale appropriate projects that will restore the equivalent amount of fish-years lost.

In order to apply an equivalency methodology successfully, the Trustees must take into consideration several factors. Some of these factors are described below (see 43 CFR 11.83).

1. Is the baseline ecological value of injured natural resources great enough to warrant the short-term impact that might be associated with physical restoration?

2. What is the nature of the loss associated with the injured natural resources? Have the ecological services of the habitat been completely eliminated, or does the habitat retain some percentage of its baseline services? How does the life history of the organisms (reproductive rate, longevity, etc.) affect the number of generations impacted?

3. How should the Trustees describe the recovery path of the injured habitat or resource? Is recovery linear (i.e., will habitat quality improve at a constant annual rate), or will the rate of recovery change throughout the time period it takes for the injured habitat or resource to recover?

4. When will the first compensatory projects, such as habitat or replacement organisms, be provided and on what schedule will the Trustees receive the remainder?

5. What level of replacement services will compensatory restoration projects provide? Will the characteristics of compensatory habitat or replacement organisms represent the full ecological services that were injured? If not, how many years will pass before maximum services are achieved, and at what rate? At full restoration, will the compensatory habitat have the same ecological services as the baseline services of the injured habitat, or will it be necessary to apply additional compensatory restoration projects?

The following steps describe the process the Trustees would use to complete the habitat equivalency analysis or resource equivalency analysis or perhaps both:

Habitat Equivalency Approach (HEA)	**Resource Equivalency Approach (REA)**
Inventory habitats (e.g., wetlands) that have been injured. The primary source of information for this inventory would be the results of sampling undertaken as part of this assessment.	Inventory organisms (e.g., fish, birds) that have been injured. The primary source for this inventory would be the results of collections undertaken as part of the initial response efforts.
Characterize the nature and extent of the injury, including the size of each parcel in which injury has been documented, and the loss of services relative to baseline.	Characterize the nature and extent of the injury, including extrapolating from the number of injured organisms collected during response efforts to the true number of organisms injured in the overall population.

Habitat Equivalency Approach (HEA)	Resource Equivalency Approach (REA)
Document all other inputs to the analysis, including period of loss, length and type of assumed recovery, discount rate, etc. Each input would be accompanied by clear explanations of all assumptions.	Document all other inputs to the analysis, including period of loss, life histories of representative species, discount rate, etc. Each input would be accompanied by clear explanations of all assumptions.
Calculate the present value loss, for example, in "wetland-acre-years", including documentation of the sensitivity of the analysis to any major assumptions.	Calculate the present value loss, for example, in "fish-years," including documentation of the sensitivity of the analysis to any major assumptions.
Scale restoration options for compensatory habitat, including current services being provided, year restoration will begin, length of recovery, etc.	Scale restoration options for compensatory projects (may consist of habitat improvement/ acquisition, fish-stocking, predator exclusion) including current services being provided, year restoration will begin, length of recovery, etc.

Upon completion of the analysis, the Trustees could proceed to inventory and assess potential "compensatory" habitats and to develop options for sets of habitats that would provide services equal to those that had been lost.

Implementation of the Damage Determination

As required by the DOI regulations, the Trustees will consider the following factors during the process of calculating natural resource damages (see generally, 43 CFR 11.71, 11.83, and 11.84).

Double Counting

Due to the ability of natural resources to provide more than one service, it is possible that a benefit or cost could be counted more than once during the damage determination, particularly during the estimation of compensable damages. For example, use of a survey-based methodology to measure the public's willingness-to-pay to restore a recreational fishery could double count a damage estimate based on a direct assessment of the value of lost trips to the fishery, since the survey would presumably capture at least some of the value the public places on their use of the fishery. The regulations specifically instruct the Trustees to avoid double counting. Thus, the Trustees will take appropriate steps to identify and account for any double counting that might result from the application of compensable damage methodologies such as those described above. In addition, the Trustees will incorporate the effects of response actions into the estimation of damages in order to ensure that the damages account only for residual injuries.

Uncertainty

The assessment shall explicitly incorporate and report on uncertainty in the various assumptions and variables used to calculate damages, and the effect that these factors have on the resultant damage estimate. Such uncertainty analysis shall include, where appropriate, the derivation and application of probability estimates for the important assumptions and factors used to determine damages.

Discounting

The Trustees will estimate damages in the form of expected present values. The DOI regulations provide specific guidance for determining the appropriate discount rate for present value calculations (43 CFR 11.84(e)).

Substitution

As part of the calculation of compensable values, the Trustees will incorporate estimates of the public's ability to substitute resource services or uses for those of the injured resources. For example, estimation of lost or diminished recreational fishing opportunities will consider the availability and use of substitute fishing opportunities outside of the assessment area.

Scope of the Analysis

Trustees are required to consider the scope of the analysis before estimating compensable values. In this case, the scope of the analysis will extend to the state level, including injuries to resources managed by the INDU, and thus compensable values will include those accruing to the state of Indiana and its residents. Residents of other states also suffer losses as a result of injury to resources in the assessment area, including INDU, and thus will also benefit from restoration activities.

The DOI regulations require the Trustees to develop a Quality Assurance Project Plan (QAPP) that "satisfies the requirements listed in the NCP and applicable EPA guidance for quality control and quality assurance plans" (43 CFR 11.31(c)(2)). Such a plan is needed to ensure the validity of original data collected as part of the NRDA. An individual data gathering activity requires a QAPP that is tailored to that specific activity; therefore, since the Trustees have not yet finalized specific data collection activities (particularly those involving the collection of environmental samples), it is not appropriate to include detailed QA documentation as part of this Assessment Plan. The Trustees will develop QAPPs, as necessary, for inclusion in the detailed plans describing specific data collection tasks.

In general, a QAPP must provide sufficient detail to demonstrate that:

- The project technical and quality objectives (i.e., data quality objectives, when used) are identified and agreed upon;
- The intended measurements or data acquisition methods are appropriate for achieving project objectives;
- Assessment procedures are sufficient for confirming that data of the type and quality needed and expected are obtained; and
- Any limitations on the use of the data can be identified and documented (USEPA 1994).

Accordingly, QAPPs developed for this assessment will include the four types of elements called for by the USEPA, as described below.

Project Management

This group of QAPP elements covers the basic area of project management, including the project history and objectives, roles and responsibilities of the participants, etc. These elements ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planning outputs have been documented. Project management elements include project organization, problem definition and background, project description, and quality objectives and criteria for measurement data (USEPA 1994).

Measurement/Data Acquisition

This group of QAPP elements covers all aspects of measurement system's design and implementation, ensuring that appropriate methods for sampling, analysis, data handling, and quality control are employed and are properly documented. Measurement and data acquisition elements describe the requirements related to the actual methods to be used for the collection, handling, and analysis of samples, as well as the management of the resulting data. Measurement and data acquisition elements include sample handling and custody requirements, analytical methods requirements, and instrument testing, inspection and maintenance requirements (USEPA 1994).

Assessment/Oversight

This group of QAPP elements addresses the activities for assessing the effectiveness of the implementation of the project and associated QA/QC. The purpose of assessment and oversight is to ensure that the QAPP is implemented as prescribed. Assessments include, but are not limited to, peer review, management systems review, and technical systems audit (USEPA 1994).

Data Validation and Usability

This group of QAPP elements covers the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether or not the data conform to the specified criteria, thus satisfying the project objectives (USEPA 1994).

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Baseline The condition or conditions that would have existed at the assessment area if discharges of oil or releases of hazardous substances had not occurred.

Benefits transfer The application of existing values, data, or models to a new valuation problem.

Benthic Occurring on the bottom of a body of water.

Biota The animal and plant life of a region.

Committed Use A current public use or a planned public use of a resource for which there was a documented legal, administrative, budgetary, or financial commitment established before the release of the hazardous substance was detected.

Compensable value The amount of money required to compensate the public for the loss in services provided by injured resources between the time of discharge or release and the time the resources and the services provided by those resources are fully returned to their baseline conditions.

Damages The amount of money sought by natural resource Trustees as compensation for injury to, destruction of, or loss of natural resources. The measure of damages is the cost of restoration, rehabilitation, replacement and/or acquisition of the equivalent of injured natural resources and the services those resources provide. Damages may also include the compensable value of all, or a portion of, the services lost, as well as the cost of conducting the natural resource damage assessment.

Depauperate Falling short of natural development or size (individual organism) or composed of few kinds of organisms (ecological system).

Exclusive Economic Zone (EEZ) An oceanic zone under the control of, and for use by, the United States extending 200 nautical miles seaward from all shores.

Extirpation Complete removal or destruction.

"Facultative" organism An organism able to live and thrive under more than one set of conditions; adaptive.

Fauna The animal or animal life occurring, developed, or adapted for living in a specific environment.

Hardness A quality of water generally measured as the concentration of calcium and magnesium in the water.

Injury A measurable adverse change, either short- or long-term, in the chemical or physical quality or the viability of a natural resource resulting either directly or indirectly from exposure to a discharge or oil or release of a hazardous substance.

Insectivorous Depending on insects for food.

in situ (ex situ) In place (not in place).

Lesion An abnormal change in the structure of an organ due to injury or disease.

Macroinvertebrates Are small aquatic animals and the aquatic larval stages of insects. They include dragonfly and mayfly larvae, snails, worms, and beetles.

Motility An animal's ability to move from one location to another.

Freshwater Mussels Common name for members of several families of bivalve molluscs, inhabiting lakes, ponds, rivers, creeks, etc.

Natural resources Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government, foreign government, or Indian tribe.

Non-point source Pollution from broad areas (e.g., fertilizer and pesticide application and leaking sewer systems) rather than from discrete points.

Pathway The route or medium through which oil or a hazardous substance is or was transported from the source of discharge or release to the injured resource.

Phytotoxic Poisonous to plants.

Point source Pollution originating from any discrete source (e.g., outflow from a pipe or ditch).

Riparian Of or relating to, or living or located on, the bank of a watercourse or lake.

Riverine Formed by, living, or situated on the banks of a river.

Services The physical and biological functions performed by a resource, including the human uses of those functions. A resource may provide a service to another resource (for example, habitat for fish is a service provided by surface water).

Trustee A designated federal or state natural resource management agency or an Indian tribe that has the authority to commence an action for natural resource damages.


Cross section of a typical Michigan dune field (Wilson 1975)